

444. a

SOME
ACCOUNT
OF K. *England*
MINES,

And the *Advantages* of them to
this KINGDOM.

With an *APPENDIX* relating
to the MINE-ADVENTURE in *Wales*.

Fert Britannia Aurum & Argentum.

Tacitus in vita Agricolæ, cap. 10.

Fodinæ sunt Scholæ Optime Philosophorum.

Paracelsus de Metallis & Mineralibus, lib. 1.

Τὰ γὰρ μὲν ἀργυρεῖα εἰ κατασκευαδεῖν ὡς δεῖ, πάν-
πολλα ἂν νομίσω χρήματα ἐξ αὐτῶν ποιεῖναι.

Xenophontis Opera (edita per Stephanum) p. 539.

L O N D O N,

Printed by W. B. for John Wyat, at the Rose in
St. Paul's Church-Yard. MDCCVII.



TO THE
GOVERNOUR
AND
COMPANY
OF THE
Mine-Adventurers
Of ENGLAND,

The following Sheets concerning
MINES and METALS are,
with all due Respect, Dedicated
and Presented by

A hearty Well-wisher to their Undertaking.

THE

OF THE

COLLEGE NO. 1

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The following sheets containing
Mines and Metals etc.
with the object of
and the same by

A copy of the same is to be distributed

THE PREFACE.

AT this time, when so many People are so very Industrious to discover and to work Mines, and appear so very sensible of the great Advantages both to the Publick (a), and to Private (b) Persons from such Undertakings; and have entred themselves into Societies, and obtained Patents from the Crown to enable them in a Corporate Capacity to dig and work such Mines, as they shall be legally entitled unto, and to buy and refine Ore by a joynt Stock (c), the Publishing of the following Sheets (which were drawn up at some Hours of Leisure from more important Studies) will not probably be thought unseasonable, nor prove unwelcome to the Seekers of Subterraneous Treasure, and to the Lovers of Metallick Knowledge. It is certain, that this Kingdom of England and the Dominion of Wales, do much abound in Mines: And I cannot but wonder, that no more Pains are taken in search of them, especially in

(a) See Chap. 5. (b) Πολλοὺς γὰρ ἐν τῶν μετὰ τῶν οὐρανίων οὐρανίων πλουτοῦμένους ἰδιώταις. Xenophon, p. 539. Mr. Waller's Essay, p. 24. (c) Familiar Discourse of the Mine-Adventure, p. 104.

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the Eastern Parts of the Nation ; where I have observed a general Silence and Neglect, as to any such thing, from an Opinion that has been taken up without any good Grounds, that there are no Mines in them. But though I cannot yet say in the Words of Agricola (d) that in those Parts, naturalia venarum signa observavi, yet this I do affirm contrary to the common Opinion, and have proved it by Matter of Fact (e) ; and therefore beyond all Contradiction, that Mines are found in all sorts of Terrestrial Matter, and in rich as well as poor Land, in the Champion in plain and level Grounds, and fruitful Valleys, as well as in craggy Rocks and barren Mountains.

Neither do Mines seem to have been always such strange and improbable things in that Part of the Kingdom ; for I find that Sir John Petrus inclines to think, that the Money, which Cunobeline Prince of the Trinobantes, coined at Camelodunum in Essex (where he was seated Anno Mundi 3944) was drawn from a Mine in that County (f).

There seems also to have been a long time after this a Tradition concerning Mines in the Kingdom of the East-Saxons (g) (which was the Fourth in order of the Heptarchy, and comprehended the Counties of Middlesex, Essex and the Eastern Part of Hertfordshire, which is divided from the rest of that County by Ermin-street, or the Roman

(d) *Lib. de re Metallica*, p. 25. (e) *Chap. 14.* (f) *Fodim. Regales*, p. 11. (g) *ibid.*

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High-way, *that goeth from Waltham-Cross to Royston.*)

Afterwards I find, that King Henry IV, by his Letter of Mandamus, dated May 2. Anno Regni 2^{do}, as appears from the Records in the Tower (h), commands Walter Fitz-Walter, upon Information of a concealed Gold-Mine in Essex, to apprehend all such Persons, as he in his Judgment thinks fit, that do conceal the said Mine, and to bring them before the King and his Council, there to receive what shall be ordered.

What the Issue was of this enquiry, and whether the Mine was discovered I cannot find: But this is certain, that Gold has been extracted from several of our Mines of Tin and Copper in Cornwall, Devonshire and Cumberland (i). And the Tanners of Cornwall do now frequently find little Quantities of Gold and Silver among the Tin-Ore (k); which has encouraged that ingenious Gentleman Mr. Robert Lydall of Truro in the same County to Petition the Queen for her Letters Patents for the sole Use of a new Invention of refining and separating Gold and Silver from Tin by Precipitation, in a Reverberatory Furnace by means of some peculiar Fluxes: Which Her Majesty, as being desirous to promote all endeavours tending to the Publick good of the Kingdom, and to encourage so commendable an Undertaking, was

(h) Rot. 34. (i) Camdens Britannia (new Translation) p. 37 & 821. (k) Curiosities of England, p. 24.

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Pleased readily to Grant, bearing date June 23, 1702.

And though Gold has been hitherto found separated, or extracted but in small quantities, who knows what Discoveries Time and Industry may make? it being very possible in the nature of the thing, that it may sometime be drawn from our Mines in great Quantities, which would be of vast advantage to the Nation.

About twenty Years ago, two Gold-Mines were discovered; one at Pullox-Hill in Bedfordshire, the other at Little Tawnton in Gloucestershire; and The Society for Royal Mines claimed and seized them for the King, and granted two distinct Leases of them to some expert Refiners, who extracted some Gold from the Ore of those Mines, but did not go on with the Work, the Gold, as it is said, not always requiting the charge of Separation, though sometimes it did (l).

*As to the Law concerning Mines (of which more hereafter (m)): In short it is this. ' If
' any Mine or Metal be found in any Ground,
' it pertains to the Lord of the Soil, unless it
' be a Mine of Gold or Silver, which used al-
' ways to belong to the Crown, in whose Ground
' soever it be found; except the Gold or Silver
' be found mixed with any other baser Metal,
' as Copper, Lead, Iron or Tin, (as 'tis usually
' in this Country) in which case the Crown, by*

(l) Sir John Pettus's Essay. (m) Chap. 3.

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‘ a late *Act* of Parliament, has only the Pre-
 ‘ *emption* of the Ore (*n*). Several Laws having
 ‘ been lately made, and this among the rest,
 ‘ which have limited the Prerogative.

‘ But yet still, if the Gold or Silver be found
 ‘ pure and unmix’d, or mixed only with Stone,
 ‘ Earth, Lank, Spar, Marchasite, Cinnabar, Vi-
 ‘ triol, &c. or any other thing besides the be-
 ‘ fore-mentioned Metals, it belongs to the
 ‘ Crown, if it will countervail the charge of
 ‘ refining.

The chief Design of making these Papers Pub-
 lick is the same with that of the Ancient Greek
 Author Xenophon, (who wrote his Excellent
 Discourse upon the Mines of Athens, in the
 XCV. Olympiad, about two Thousand Years
 ago) viz. to encourage and excite my Country-
 men to search for, and labour in the discovery of
 Mines, and vigorously to work them (*o*), since
 by this means Her Majesty would not only make a
 certain Profit by her Customs, and Her Subjects a
 secure Profit by their Mines, but rich Discoveries
 would probably be sometimes made, and conside-
 rable Additions would certainly and constantly
 be made to the general Stock of the Nation (*p*).

Indeed the afore-said Act of Parliament,
 which was passed in the fifth Year of King
 William and Queen Mary (together with a Re-

(*n*) Ibid. (*o*) Ταῦτα μὲν οὖν ἐδήλωσα τοῦτου ἕνεκα, ὅπως
 θαρσύνετε μὲν ὅτι πλείους ἀνθρώπους ἐπὶ ταῖς ἀργυραῖς ἀγ-
 μιν, θαρσύνετε δὲ χειρασκευάζεσθαι ἐν αὐταῖς, αἷς οὕτως ἐπι-
 λειψούσῃ ποτὲ ἀργυρίῳ. οὔτε τὰ ἀργυρίου ἀπὸ μὲν ποτὲ ἐσ-
 μένου. Xenophon Opera, p. 540. (*p*) Familiar Discourse, p. 98.

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peal in their first Year of a discouraging Act made in the Reign of Henry IV.) has opened a New Scene of Treasure in this Kingdom, since by occasion of it some Addition will every day be made to the publick Wealth of the Nation in good Metals drawn from our own Mines, and consequently many Millions saved to England, that before were totally lost to us, and enjoyed by Foreign Countries. For this Nation was in effect, deprived of the best Mines, till the said Act was passed in favour of the Subject; and what a vast loss has that been to the Publick? But now 'tis verily believed, the Queen will in a few Years gain more by the very Customs of Lead, by Vertue of that Act, than all Her Royal Predecessors from the Conquest, did from Royal Mines themselves before. So that if Her Majesty and her People are all Gainers by this Act, it must certainly prove a happy Law to the Nation, and to Her Majesty also: For I think it is very plain, that every Law, that enricheth the People, enricheth Her Majesty, since Her Majesties Wealth must arise from theirs (q).

And this very thing proves, what an inseparable Union there is betwixt the Interest of her Majesty and her People; for whilst their Interests in the case of Royal Mines were divided, neither Prince nor People could get any thing by them (r): But now their Interests by this Law being united, both will be great Gainers (s). So

(q) *ibid* p. 94. (r) See Chap. 3. in fine. (s) Familiar Discouric, p. 95.

that

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*that the afore-said Princes by limiting the Pre-rogative of the Crown with respect to Royal Mines, and thereby encouraging the Subject to discover and work Mines, have acted by the Example of the famous Queen Elizabeth, and been as favourable to the Lord or Proprietor of the Soil, in which Mines shall happen to be found, as she was to the Officers and Workmen im-
ployed in them; for in the tenth Year of her Reign, by the Advice of her Privy-Council, by her Letters Patents under the Great-Seal of England she discharged all Miners, and all other Persons interested in Metallick or Mineral-works, or occupy'd in finding, digging, smelting, and refining of Metals or Minerals, from paying any Fifteenths, Tenths, Subsidies, Taxes or Impositions; and set them free from serving upon Juries, and from Arrests (t); which great Priviledges were anciently granted them by the Civil-Law, which gives this Reason for them, viz. because the Charge, Care and Labour of such Works is so very advantageous to the Publick: And therefore it was thought but reasonable by the Romans, and by their Example for us, to give them encouragement by such Concessions (u).*

The same Law gives also further Encouragement to Metallick-works (w), by compelling the Children of Miners to follow their Father's Trade,

(t) Fodin. Regal. p. 30. (u) *ibid.* (w) *Hæ & aliz referuntur Leges & amplificantur in Codicibus Juris Civilis, viz. Digest. lib. 3. Tit. 4. & lib. 48. Tit. 19. Cod. l. 11. Tit. 6. leg. 1, 2, 3. &c. Fufit. lib. 2. Tit. 1. Sect. 39.*

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by disabling all Miners from following any other Occupation ; by granting to the Owner of the Ground a considerable part of the Profits ; by allowing Ecclesiasticks as well as Laicks to be Farmers of them (which in England is forbid by Statute-Law upon severe Penalties indeed (x) &c.

But though Searchers after Mines ought to have all the encouragement that may be, yet they should be cautioned from beginning such chargeable Works, or prosecuting them with too great Expectations, before they have well and maturely considered all Circumstances, as the Plenty or Scarcity of the Metal, the easiness or difficulty of coming at it because of its Depth, or its being troubled with Water ; its nearness to plenty of Fuel, and the conveniency of Water to drive Smelting-Mills ; its nearness to, or remoteness from the Sea, or some Navigable River, convenient for its Carriage and Transportation ; the cheapness or dearth of Work-men ; with other important Circumstances, which as they happen to be commodious or inconvenient, may render the Attempt adviseable or imprudent.

Such persons ought also to be provided of a sufficient Stock, to carry on their Works to advantage, and to be well assured of the goodness of their Title ; since 'tis very probable, that the Envy or Avarice of others may give them some disturbance, and if possible, find flaws in it, and take their Mine from them, after they have been at great expence and trouble to bring it to Perfecti-

(x) XXI. Hen. VIII. c. XIII.

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on : For I am afraid Xenophon's saying will not hold true in these times, that the Mining-Trade is the only Profession, where the Undertakers are never envied, be their Stock or Profits never so extraordinary (y). We have too many deplorable instances of the contrary in this Kingdom: A fresh one we have lately met with at Anlizark near Rivington in the Parish of Bolton in Lancashire, where in the Grounds of Sir Thomas Standish Baronet, a Mine of Lead was found about the Year 1700, and wrought with good Success (z), but now is at a stop, the undertakers, who have been at great expence, being very much embarrassed with Law-suits.

If it be said, that many Men have been ruined by Mines, and that is it, which discourages; to this it is answered by an ingenious Gentleman, (aa) that some indeed have been ruined in searching for Mines, and not finding them, but none were ever ruined by working of rich Mines, when they were actually found; and there are many instances of such, as have got vast Estates by Mines in a few Years. And as we say, nothing venture, nothing have, so many hundreds of Merchants think it prudent and adviseable to venture vast Sums of Money, view the farthest Countries in the World, spread their Sails to the uttermost part of the Earth for Traf-

(y)---ἀρετὴ ἐν μινῶν τοῦτο ὅτι ἐν αὐτῇ ἐργάζων οὐδὲ θάνατον οὐδέ τι τοῖς ἐπισκευάζουσιν, &c. p. 599. (z) Dr. Gibson's Additions to Camdens Britannia. (aa) Mr. Shiers's second Familiar Discourse of the Mine-Adventure, p. 22.

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sick, expose themselves and all they have to the greatest hazards of Pirates, Tempests, Storms, &c. (bb), and all this upon a bare probability, or rather possibility of a rich Return. And why should not Men be as forward to venture their Money. at home in our own Nation, in search of Mines, where there is but the least probability of finding any; especially considering. that we should thereby improve a Trade from the growth of our own Country, which would yield double the Profit, and far less Hazard (cc)?

As to the failing of the Veins of Ore, I shall only say here, that it is a common Observation, that the bottom of any fixed and settled Veins of Lead, Copper, &c. was hardly ever found; and that where a Vein happens to be found, there are usually others not far from it (dd); I say. usually; for it cannot be denied, that Bellies or Lumps of Ore are sometimes met with, tho' but rarely, by the Miners in their Searches. But to this and other (ee) Objections you will find elsewhere (ff) a fuller answer and satisfaction. And therefore I shall conclude this Preface with the words of a very Judicious and Intelligent Writer. (gg).

(bb) Mr Waller's Essay on the Mines, p. 34. (cc) *ibid.* See Chap. 11. how fortunate some Men have been in digging for Mines at a venture. (dd) Οὐτε βάθος πέρας. οὐτε ὑπόνομον δι' ὁρύσσοντες εὐεῖσκουσιν. Xenophon, p. 541. *ubicunq; una vena inventa est, non procul invenitur altera.* Plin. Nat. Hist. lib. 33. c. 6. *unde (inquit) Greci videntur, μέταλλα dixisse.* (ee) πανταεργαί μὲν εἰσιν οἱ περὶ τὰ μέταλλα. — νινδυνος δὲ μέγας ὁ κερναπμοῦνπ. — &c. Xenophon, p. 541. (ff) Chap. IX & X. (gg) Essay on the Balance of Trade, p. 94.

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‘ We have in *England*, *Lead*, *Tin*, *Copper*,
‘ *Calamy*, *Iron*, *Coal*, *Culm*, *Allum*, *Copperas*,
‘ with other sorts of *Metals* and *Minerals*; and
‘ what is in this manner dug out of the Earth
‘ cannot be a less *Article*, than about *seven* or
‘ *eight hundred thousand Pounds per Annum* in
‘ the whole *Rental* of the Kingdom. They
‘ who work these *Mines* and deal in *Minerals*,
‘ know best what *Laws* they want, to make
‘ their business more *easy* at *Home*, and to give
‘ their Commodities a free vent *Abroad*: But
‘ if they need any help from the *Legislative*
‘ *Power*, most certainly they ought to have it,
‘ since their stock and labour turn so much to
‘ the *Common Good*; for whatever their Pro-
‘ duct yields in Foreign Markets is clear *Nati-*
‘ *onal Profit* to England.

How are thy Realms, *Triumphant Britain*, blest!
Inrich’t with more than all the distant *West*.

Thrice happy Land! from whose Indulgent
Womb,

Such unexhausted store of Riches come!

Whose *Native Mines* a noble Fund maintain,
To humble *France*, and check the Pride of
Spain.

Thy Sons no more betrayed with hopes of
Gain,

Shall tempt the dangers of a Faithless *Main*;
Traffick no more abroad for *Foreign Spoil*,
Supply’d with Richer from their *Native Soil*.

By

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By Wars impoverish'd, *England* mourns no
more,
Her well-wrought *Mines* forbid her to be
poor, &c.

Mr. Yaldens *Poem on the Mines late*
of Sir Carbery Price. p. 8 & 10.

Metal-

*Metallick Writers made use of in
this Work.*

Monsieur Acarete's *Voyage to Peru,
and Description of the Mines of
Potosi.*

Acosta's *Natural History of the West-
Indies.*

Agricola de re Metallica & de Natura
Fossilium.

Alstedius de Regno Minerali.

Albaro Alonso Barba's *Art of Metals.*

The Honourable Mr. Boyle's *Physiological
Essays.*

—— *Sceptical Chymist.*

—— *Observations on the growth of Me-
tals.*

—— *Hydrostatical way of examining and
estimating Ores.*

Bosman's *Description of the Gold-Coast of
Guinea.*

Metallick Writers, &c.

Dr. Brown's *Travels to the Mine-Towns in Hungary.*

Cesalpinus *de rebus Metallicis.*

Cesii *Mineralogia.*

Lazarus Erckern (*who was chief Mine-Master to the Emperor Maximilian*) of *Ores and Mineral Bodies.* Sir John Pettus translated it from the High-Dutch by order of the Society for Royal Mines.

Eucelius *de re Metallica.*

A Familiar Discourse concerning the Mine-Adventure.

A second Familiar Discourse by Mr. Shiers concerning the Mine-Adventure.

Dr. Fritchius's *Principles of Pyrotechnical-Metallurgy.*

Dr. Kunkell's *Pyrotechnical Discourses.*

Kentmanni *Nomenclatura Fossilium.*

Kercheri *Mundus Subterraneus.*

Dr. Leigh's *Natural History of Lancashire.*

Mathesii *concio Sareptana.*

Dr. Merin's *Journey to the Mines of Hungary*

Metallick Writers, &c.

Hungary in Dr. Hayley's Collection of Voyages and Travels, Vol. 2.

Ovalle's Description of Chili in the same Collection. Vol. 4.

Mr. Gabriel Plat's Discovery of Subterranean Treasure.

Sir John Pettus's Fodina Regales.

Plinii Historia Naturalis.

Mr. Waller's Essay on the value of the Mines late of Sir Carbery Price.

---his Mapps and Account of the Mines in Cardiganshire.

Webster's Metallographia or History of Metals.

Dr. Woodward's Natural History of the Earth.

Wormii Museum.

Rosycrucian Authors, or Writers upon Alchymie.

Albertus Magnus (the learned Bishop of Ratisbon) de Mineralibus.

Bacon's Speculum Alchymie.

Metallick Writers, &c.

Basilus Valentinus's Last Will and Testament.

Dr. Dickinson de Quintessentia Philosophorum.

Geber's Arcanum Hermeticum.

Van Helmont de Lithiasi.

Sir John Heydon's Pantarva.

Libanii Alchimie Defensio.

The Prince of Mirandola's Treatise de Auro.

Morienus Romanus.

Museum Hermeticum.

Nollii Naturæ Sanctuarium.

Paracelsus de Metallis & Mineralibus,

Raymundus Lullius.

Rulandi Lex Alchymie.

Spagneti Arcanum Hermeticum.

Sendivogii Novum Lumen Chymicum.

Theatrum Chymicum Britannicum. By

Elias Ashmole, Esq;

Trevifanni Ars Aurifica.

T H E

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ERRATA.

PAGE. 8. Line 1. blot out *is*. l. 25. for *Waks* Read. *Wake*.
 p. 15. l. 24. for VII. r. VIII. l. 11. for *Matter* r. *Matters*
 p. 28. l. 19. blot out *be*. p. 40. l. penult. before *Cupfel*. r. *the*.
 p. 41. l. 15. for *of your* r. *in the*. p. 62. l. 25. for *number* r.
numbers. p. 64. l. ult. blot out *of the Subjects*. p. 82. l. 3. for
Stores. r. *Stones*. l. 12. for *an* r. *and*. p. 98. l. 1. for *Hook*. r.
Hack. p. 116. l. 9. for *Selenities* r. *Selenites*. p. 121. l. 20. for
incognite. r. *incognita*. p. 141. for *a*. r. *against*.

(I)

A N
A C C O U N T
O F
Mines, &c.

C H A P. I.

*Giving some Account of Silver-Mines in
England and Wales.*

TH O' Cicero was pleas'd to say, in one of his Epistles to Atticus, that in *his* time Britain afforded *ne micam auri vel argenti*, not one Grain of Gold or Silver, yet we are assured by Tradition, that several Mines, in which was Gold and Silver, in Devonshire, Cornwall, Somersetshire and Wales, were anciently wrought by the Romans and afterwards by the Saxons (a). And Caesar in his *Comm-n-*

(a) Sir John Pettus's *Fodina Regales*. p. 11.

tares saith, that one reason of his invading the *Britains* was, because they assisted the *Gauls* with their *Treasures*, with which their Country did abound; and it is not doubted, but that the Silver, which was here coin'd after the *Roman* way in *Augustus* his time, was taken from *English* Mines (b). And *Giraldus Cambrensis* an ancient Writer affirms; that in his time there was in *Flintshire* a *Rich Vein* of Silver discovered; in following whereof, *Itum est in viscera terræ* (c). And 'tis certain, there were Mines in *England* which did supply former Ages, as appears from ancient *Patents* and *Records*: For so we find, that Silver in great plenty was formerly found in the Parish of *Comb-Martin* in *Devonshire*, (Miners being fetcht out of *Darbyshire* for the digging of it) in the Reign of King *Edward I.* which (as appears by Record (d) on the Account of those trusted therein) turned to a considerable profit.

In the 22d year of the same Kings Reign, *William Wymundham* accounted for two hundred and seventy pound weight of Silver. It was forged for the Lady *Eleanor* Dutches of *Barr*, and Daughter to the said King, married the year before.

In the 23d year of the said King was fined

(b) *Idem ibidem.* (c) *Camdens Britannia* (new translation) p. 688. (d) Extant in the *Tower of London* in the years here noted. *Dr. Fullers Worthies of England.* p. 245.

five hundred and twenty one Pounds ten Shillings weight.

In the 24th year of his Reign, there was brought to *London* in fined Silver in Wedges *seven hundred and four Pounds three Shillings and one penny weight.*

In the 25th year of his Reign, tho' three hundred and sixty Miners were impress'd out of the *Peak* and *Wales*, yet that years profit in Silver was very great.

In the reign of *Edward III.* it appears by the Record of particular Accountants, that the Profits of the Silver were very considerable towards the maintenance of the King's great Expences in the *French War.* These Mines after they had been long neglected (by reason it is supposed of the Civils Wars betwixt the Houses of *York* and *Lancaster*) were re-entered on by one *Bulmer* an Artist in the Reign of Queen *Elizabeth*, but with what success it is not said; only 'tis certain they did not regain their former Credit.

In the Parish of *Bear-Ferris* in the same County of *Devon* near the Sea were Silver Mines in the Reign of *Henry VI.* which were lately re-enter'd on by *Sir John Maynard*, but have been since discontinued (e).

It is not doubted, but the *Romans* digged for Silver as well as Lead in the Mountains in *Wales*, and found plenty of both. However this is certain, that *Customer Smith*, about the

(e) The Additions to the new Translation of *Camdens Britannia*
B 2 latter

latter end of the Reign of Queen *Elizabeth*, discovered Silver in the Mountain *Consonlock* in *Cardiganshire*, and sent it up to the Tower of *London* with great expence to be coined; (f). and after his death the design was prosecuted and more perfected by Sir *Hugh Middleton*, who coined the Silver to his great charge, as his Predecessor did, at the Tower. He paid 400*l.* per annum Rent to the Society for *Royal Mines*, and cleared monthly the Sum of 2000*l.* And had he not diverted his Gains to the making of the new River from *Ware* to *London*, certainly he would have been Master of a Mass of Wealth. But great Wits and Purfes seldom know how to set bounds to their designs, and by undertaking too many things, fail in all (g).

After the Death of Sir *Hugh Middleton*, Sir *Francis Godolphin* of *Cornwall*, and *Thomas Busbel* Esq; undertook the Work. And King *Charles I.* for their greater encouragement and sparing their Expence, granted them power of Coinage at *Aberrusky* in that County; the Shillings and Half-Crowns, &c. of this Silver had the *Ostrich-Feathers* (the Arms or rather the *Device* of the Prince of *Wales*) for distinction stamped upon them (as those have which are now coined by the *Mine-Adventurers*.) But Sir *Francis Godolphin* dying soon after, Mr. *Busbel* went on with the Works by himself; and not being

(f) Dr. *Fulles's Worthies in Wales.* p. 3. (g) *Fodina Regales* p. 33.

disheartned, that the first year and half afforded no effectual discovery, at last these Mines yielded 100*l.* per week, in Silver, besides Lead, amounting to half as much.

Then came the Civil Wars, and discomposed the whole Work, or else probably by this time it had arrived at a greater perfection (*b*). Some of this *Welch-ore* yielded in Silver per Tun 14*l.* besides the Lead, (*i*) and some yielded 20*l.* per Tun.

But a certain Author (*k*) tells us, that he knew two places in the *West-Riding* of *Yorkshire*, where formerly good Silver-Ore had been gotten, that yielded better. The one is called *Brunghill-Moor*, in the Parish of *Slaidburn*, where about 70 Years since Sir *Bevis Bulmer* got good store of Silver-Ore, that held about 67*l.* per Tun. The other was within the Township of *Rimington* in the Parish of *Gisburn* in *Craven*, in a Field called *Skelkorn* belonging to one Mr. *Pudsey* an ancient Gentleman, and owner of *Bolton-hall juxta Bolland*, who in the Reign of Queen *Elizabeth*, did there get good store of Silver-Ore, which yielded in Silver 26*l.* per Tun. This he converted to his own use, or rather coined it (as many do believe, there being many Shillings marked with an *Escalope*, which the People of that Country call *Pudsey's* Shillings to this day ;) but whether way soever it was, he procured his par-

(*b*) *Fodina Regales* p. 10. (*i*) *ibidem*. (*k*) *Metallographia*, p. 20. and Dr. *Fuller* p. 4.

don for it, and had it, as those did testifie, who had seen it.

To the former of these places one *Walter Basby*, on old expert *Affay-master* (who had been in the time of King *James I.* sent to the Emperor of *Russia* to settle the *Standard* of his Coin) was brought down by some *Londoners* in the year 1655. who had got a *Patent* for *Royal-Mines*. But they being Men neither of free Purfes to follow such a Work, nor of skill and government fit to manage such an Enterprize, at last deserted the poor old Man, whom a neighbouring Gentleman entertained, and got some of the Ore pick'd out of the old rubbish of the Works, that *Sir Bevis Bulmer* had left, and caused him to make several tryals, which yielded near to the quantity of Silver in a Tun, as is before specified, tho' it was none of the best Ore (l).

As to the famous Mines in *Cardiganshire*, which are now working with so much vigor and application by the *Company of Mine-adventures*, many thousand Ounces of Silver have been lately extracted from them, particularly 2858 Ounces of this *Welch-bullion* were minted at one time in the latter end of the year 1704 at the *Tower*. All persons, who extract any Silver or Gold out of any Mine in the Queens Dominions, being obliged by the Act of Parliament in the first year of King *William* and

(l.) *Idem*, p. 21.

Queen *Mary*, to carry it thither to be coined into Money.

Sir *John Pettus*, who was one of the Deputy Governours of the *Mines Royal* for above thirty years, is very confident, that we have several *Lead-mines* in *England*, which would yield in every Tun of Ore from 20*l.* to 80*l.* of clear Silver (*m*).

We find that in other Countries, as in *Misnia* at the Mines of *Freiberg*, they will work the Ore, though it holdeth but *half an Ounce* of Silver in a *hundred Pound weight*; nor is this much to be wondred at; for in the vast rich Mines of *Chili* and *Pernu*, they will work the Silver-Ore, which containeth (as one saith) (*n*) but one Ounce and a half of Silver in an hundred Ounces; or (as another (*o*) affirms) but four or five Ounces in a hundred Pound weight; and ten or twelve Ounces is the ordinary rate of the common Ore of the rich Mine of *Potosi*: Which Mine alone, if we believe *Alvaro Alonso Barba*, Curate of the Parish of *St. Bernard* in that City, had already yielded in the Year 1640, between four and five hundred Millions of Pieces of Eight (*p*).

The *Mine-Adventurers* have lately recovered the old Silver-Mines in *Cardiganshire*, (which were wrought by Sir *Hugh Middleton*, Sir *Francis Godolphin* and Mr. *Busshel*) in fresh

(*m*) His Essay on Metallick Words. (*n*) New State of England Part I. Chap. 4. p. 21. (*o*) Dr. Brown in his Travels, p. 135.
 (*p*) A Piece of Eight is about 5 Shillings Sterling.

Ground ; five of which are is very rich in Silver ; and in one of them, *viz.* the famous Mine of *Consumblock*, they have by the force of Gunpowder got through that Rock, which the old *Romans* left behind them, as never to to be conquer'd, and are enter'd into the Vein between firm and solid Sides, two foot wide in Ore mixt with Vein-stone, and about one foot wide in pure Ore, that yields *sixty five* Ounces of pure Silver in a Tun (*q*).

The Ingenious Sir *Hugh Middleton*, as was said before, took a Lease of this Mine of the *Patentees* of Royal Mines, and cleared the Sum aforesaid yearly, as appears by his Books of Accounts ; and Sir *Hugh* having by an *Engine* wrought this Mine several Yards under Water, the *Patentees* some Years after his Death, endeavoured to bring up an *Addit* to go under this Work, at the expence of *eleven thousand Pounds*, as Sir *Edmund Wallcup*, and others of the *Patentees* then of that *Committee* can inform you ; but they struck much short of reaching his Bottoms ; and though that Vein has been attempted by many, yet it was never recovered till now, since Sir *Hugh Middleton's* Death (*r*).

Another of their Mines in the same County is that of *Goginian*. Mr. *Bushel* kept a Mint at Work at the Silver-Mills in this County of

(*q*) The second Familiar Discourse of the Mine Adventure. p. 31. (*r*) Mr. *Waller's* Mapps and Description of the Mines, p. 6.

Cardigan, with the Bullion he had from this Mine ; and is said (s) to have cloathed King *Charles Ist's* whole Army from part of his Profit in this Work, which now yields *forty four* Ounces of fine Silver *per Tun*, in every Tun of Metal made of that Ore (t). The Ore also of the Mines of *Brinpica*, *Comarvin* and *Pencraidd* in the same County, holds *forty four* Ounces of fine Silver in every Tun of Metal made of that Ore (u.)

CHAP. II.

Of the Powers granted by the Kings of England, concerning Mines, and the Erecting a Corporation by the Name of The Society for Mines Royal.

IT is very plain from the following *Grants*, that the Kings of *England* have formerly claimed *all* Mines, whether of *Gold*, *Silver*, *Copper*, *Tinn*, *Iron*, *Lead*, *Quick-silver*, *Allum*, &c. as equally belonging to the *Prerogative* of the Crown ; and accordingly from time to time disposed of them, as they thought fit, giving them away, letting or selling them.

Thus *Edward III.* in the 13th Year of his Reign, by *Letters Patents* granted to his Bro-

(s) *Fodina Regales*, p. 34. (t) *Description of the Mines*. p. 8.
(u) *ibid.*

ther *Richard Duke of Gloucester, Henry Earl of Northumberland*, and others, the *Copper-Mines of Skildane in Northumberland*, and the *Copper-Mine of Alston-Moor in Cumberland*, and the *Copper-Mine near Richmond in Yorkshire*, to hold for fifteen Years, paying to the King the *eighth part Neat*, and to the Lord of the Soil the *ninth*, as they arise (a.)

The same King in his 18th Year, by his *Letters Patents* granted to *William Goderswick*, all Mines of Copper and Lead in *Northumberland* and *Westmoreland* (not granted before) for ten Years, paying to the King a 15th part *Neat*, and to the Lord of the Soil, as they can agree.

The same *Edward III. Anno Regni 32*, by an Indenture dated *July 11*. granted unto *John Ballanter* and *Walter Bolbolter*, all his Mines of *Gold, Silver* and *Copper* in the County of *Devon*, for two Years, with liberty to dig and search in any Mans Ground (except in Gardens) and all other Persons are excluded from digging there (b.)

Richard II. by his *Letters Patents, Anno Regni Octavo*, granted to *Richard Waks Clerk*, his Mines of *Gold* and *Silver*, in the County of *Devon*, with Power to dig and search, as well within Liberties as without, for ten Years, paying to the Exchequer the 9th part, and all other Persons to be excluded, *prout ante* (c.)

(a) *Fedine Regales* p. 19. (b) *ibid.* (c) *ibid.*

Henry IV. granted to *Edward* and *John Darby*, all the Lead-Mines holding Silver in the County of *Devon*, and made *William Charlton* the Prior of *Pilton*, Comptroller thereof (d).

Henry VI. by his Letters Patents dated February 24, in his fifth Year, granted to *John Duke of Bedford*, Regent of *France* and Protector of *England*, all Mines of Gold and Silver within his Kingdom of *England*, for 10 Years, paying to the King the 15th part, and to the Lord of the Soil the 20th part (e).

The same King in his 34th Year granted to the Duke of *York*, all Mines of Gold and Silver, within the Counties of *Devon* and *Cornwall*, to hold at the Pleasure of the King for 21 Years, with a Clause not to dig under the Houses of any Subjects (f.)

The same King by Letters Patents under the Great Seal of *England*, granted to *John Botwright* all Mines of Copper, Tinn and Lead, (in the Counties aforesaid) whereout any Silver shall be fined, or Gold extracted; and Power to dig without Interruption. Dat. Junii 20. Anno 31. Rot. 20 & 25.

In the 36th Year of this King's Reign, one *Robert Glover*, by the command of *Roger Champernoon* Esq; got some Bowls of Silver ore, and made profit of the same, out of a Mine at *Bear-Ferris* in *Devonshire*: Of this the said

(d) *ibid.* (e) *idem.* (f) *ibid.* p. 17.

Botwright complained to the Court of *Exchequer*, and affirmed, that nothing had been allowed to the King or his Grantees, to the King's Damage 100*l.* and thereupon desired Judgment of the Court against the said *Champernoon*, notwithstanding that the Mine was found in his Ground (g).

Edward IV. by his *Letters Patent*, dated December 20. *Anno Regni Octavo*, to *Richard Earl of Warwick*, *John Earl of Northumberland*, and others, Grants all Mines of Gold and Silver on the North-side of *Trent* within England, and all Mines of Lead, holding Gold or Silver in the Parts aforesaid, to hold for forty Years, paying to the King the twelfth part of pure Gold and Silver, with Liberty to dig and search, without Licence, except under Houses and Castles (h).

The same King, by his *Letters Patents*, granted to *William Goderswick* and *Doderick Vaverswick* (upon the surrender of the former Patent) all Mines of Gold, Silver, Copper and Lead in *Northumberland* and *Westmoreland*, to hold for ten Years, paying to the King a fifteenth part, *Neat*, and to the Lord of the Soil, as they can agree (i).

Henry VII. by his *Letters Patents*, dated February 27. in the first Year of his Reign, made and constituted *Jasper Duke of Bedford*, and others, Earls, Lords and Knights, Com-

(g) In the Records of the *Exchequer* in Easter Term in that Year. (h) *Fodine Regales*, p. 18. (i) *ibid* p. 19.

missioners and *Governours* of all the Mines, not only of *Gold* and *Silver*, but of *Tin*, *Lead* and *Copper* in *England* and *Wales*, to hold for twenty Years, paying to the King the fifteenth part of pure *Gold* and *Silver*, and to the Lord of the Soil the eleventh part, as it grows, with Liberty to dig and search, &c. except under the Houses and Castles of the King and his Subjects (k).

Queen *Elizabeth*, by the Advice of her Council, sent over for some *Germans*, experienc'd in Mines; and in the sixth Year of her Reign did grant unto two of them, viz. *Daniel Houfketter* and *Thomas Thurland*, full Licence and Power, to dig and search for Mines or Ores of *Gold*, *Silver*, *Copper*, *Quick-silver*, &c. in these eight Counties, viz. *Yorkshire*, *Lancashire*, *Cumberland*, *Westmoreland*, *Cornwall*, *Devon*, *Glostershire*, *Worcestershire*, and in *Wales*, to try and convert the same to their own Profit; only reserving to her self the tenth part of all *Gold* and *Silver-Ore*, holding and yielding eight pound weight of clear *Gold* or *Silver*, or upwards in every hundred weight; and for their encouragement she discharged them from paying of *Subsidies*, *Fifteenths*, and all other *Taxes* whatsoever (l).

In her seventh year she granted by *Letters Patents* to *William Humphrey* and *Christopher Shutz*, all manner of Ores, *simple* and *pure*, or

(k) *ibid.* (l) *ibid.* p. 49, & 50.

mixt and compound, of the Metals of Gold, Silver, Copper, Quick-silver, Lead, and Cadmi-an-ore, and all other Minerals and Treasures which should be found in Earth or Ground in England, and the English pale in Ireland, (the eight Counties before granted to others excepted) with Licence and Power to dig and to build Houses for their use; the disturbers of their Workmen to be committed for six months without Bail or Mainprize: she also impowred them to take up necessities for the work, as Fuel, Timber, &c. at reasonable Rates, they to pay the Queen for every hundred weight of Gold-ore eight pound weight of fine Gold, and for Silver the 20th part. She to have the pre-emption of the Ores, paying in every ounce of Gold 8d, and of Silver one Penny less than she can buy elsewhere; the Money to be paid by her within 30 days. None to use their Tools or Instruments, or to dig and search, but themselves, for the space of 21 years (m).

And in her 10th year, May 28 (the same day and year on which she incorporated the *Society for Royal Mines*) she erected a Corporation by the name of the *Society for the Mineral and Battery Works*. King James I. in his first year renewed and confirm'd this Charter. The Principal Members of this Body Politick at that time were William Earl of Pembroke, Ro-

(m) *ibid.* p. 57.

bert Lord Cecil, Sir Julius Caesar, Sir James Pemberton, Sir James Lancaster, Knights, John Osborn, Thomas Caesar, Francis Bartu Esq; &c. to whom and to their Successors, were granted all the Powers, Priviledges, Profits, and Immunities formerly granted to Humphry and Shutz, that is, to dig and search for all sorts of Ores, &c. But those eight Counties and all Wales being granted to the Society for Royal Mines, where Gold or Silver-mines were thought to be most likely to be found, this Society applyed themselves chiefly to the Battery-works, i. e. to Manufacture the Copper and Brass fit for the use of the Brasier and other Artificers, which turned to great account.

In her tenth year also she took from the Earl of Northumberland a rich Copper-Mine at Keswick in Cumberland; (whereby it came to pass, as one observes (n.) that this Queen left more Brass then she found Iron Ordinance in the Kingdom.) It being resolved by nine of the twelve Judges, upon a Tryal at Law betwixt the Queen and that Lord, that tho' Henry VII. had granted the Mannor of Keswick to him, with all Mines within the said Mannor, yet the Mines could not pass; and that tho' the Grant of the Mannor was good, yet the King could not alienate Mines, as being things perfectly linked to the Prerogative of the Crown; and that notwith-

(n) Dr. Fuller's Worthies in Cumberland, p. 215,

standing his Grant, the Queen had power to dig and search for Metals and Treasure in any Man's Ground (o). Tho' Mr. *Camden* saith, the *Suit* was carried in favour of the Queen, by reason of the mixture of *Gold* and *Silver*, that was found in the Veins of *Copper* (p). The same is affirmed by Sir *William Dugdale*, (q) who saith, the rich Mine of *Copper*, found in the Lands of that noble Lord, was adjudged a *Mine-Royal*, and consequently to belong to the *Crown*.

The same Queen, by her *Letters Patents*, granted to *Cornelius Devoz*, and others, power of mining and digging, within her Realm of *England*, and the *English* Pale in *Ireland*, for *Allum* and *Copperass*, and divers other Ores and *Minerals* (r).

King *James I.* afterwards ratified and confirmed this Grant (s.)

In this Kings Reign some *Allum-mines* were discovered by Sir *Thomas Chaloner* (Tutor to Prince *Henry*) in *Yorkshire*, but some years were pass'd, before they could be brought to Perfection : Some of the Gentry of the Neighbourhood burying their Estates under the Earth, before the *Allum* could be brought to its true consistency. But when the work was finished, it was adjudged a *Mine-Royal*, and came at last to be farmed and rented by Sir

(o.) The Earl of Northumberland's Case in *Flowden's Reports*
 (p.) *Britannia*, new Translation, p. 821. (q) in his *Barbony* of
England, Tome 1. p. 283. (r) *Fodin. Regal.* p. 60. (s) *ib.* p. 62.

Paul Pindar, who paid *twelve Thousand five Hundred Pounds* yearly for it to *King Charles I.* and employed in it above *eight Hundred Men*. But the *Long-Parliament* voted it a *Grievance* and *Monopoly*, and restored the *Benefit* thereof to the former *Proprietors* (t.)

Indeed some of the *Kings of England* have claimed and challenged *only* such *Mines* out of which *any Gold* or *Silver* could be got and extracted. And this agrees with their *Opinions*, who have treated of *Metallick Matter*; and with the *Records* of the *Exchequer*, which prove, that the *King* had the *Mines* of *Copper* and *Lead*, containing or holding *Gold* or *Silver*, although the *Gold* or *Silver* be of the less value (u.)

But this comes to the same thing with the former claim, and shews, that the *Crown* has been intituled to all the *Mines* of any sort of *Metals*; for we having yet discovered no *Mine* of *Gold* or *Silver*, that was *pure* and *unmixed* and needed *no refining*: And all *Writers* of *Metals* agreeing and affirming, that there is naturally some proportion of *Gold* or *Silver* in every other *Metal*; and the *Smelters* and *Refiners* making it evident, that there is in *Copper* naturally *Gold* and *Silver*, and in *Lead*, *Iron* and *Tinn* naturally *Silver*. Upon this account and reason, all *Mettals* whatsoever might be claimed by the *Prerogative*, and the

(t) *Dr. Fuller's Worthies in York-shire* p. 126. (u) *Plowdens Reports*, in fine.

Crown intituled to them; for there is not any such Mine either in this Kingdom or elsewhere, which hath not some Gold or Silver in it (w.) And this occasioned that *Clause* in an *Act* of *Parliament* made in the *first* Year of King *William* and Queen *Mary*; wherein amongst other things it is enacted, That no Mine of Copper, Tin, Iron or Lead, shall hereafter be adjudged, reputed or taken to be a Mine-Royal, although Gold or Silver may be extracted out of the same.

The Law-Suit aforesaid betwixt Queen *Elizabeth* and the Earl of *Northumberland*, being ended; to prevent the like occasion of dispute for the future, the said Queen did, May 28. in the tenth Year of her Reign, by her *Letters Patents* under the great Seal of *England*, erect a *Corporation*; of which *William* Earl of *Pembroke* was the first Governour, and *Robert* Earl of *Leicester*, *James* Lord *Mount-joy*, Sir *William* *Cecill*, Assistants; and many other Persons of Quality were joined to them, consisting in all of 24 Persons, and as many *Shares*, and those *Shares* subdividable into half and quarter-parts, so that they might consist of ninety-six Persons; their Votes being according to the proportion they had of *Shares*. And she granted and confirmed to them and their Successors, the same Power, Licence, Liberties and Priveledges formerly granted to

(w) Sir *John* *Pettus's* *Fodina Regales*, p. 53. and *Plowdens* *Reports*, in fine.

the two Germans, *Hongfetter* and *Thurland*; and incorporated them for ever and their Successors by the Name of, *The Governours, Assistants, and Commonality of the Mines-Royal*, and so to continue for ever. This Society is commonly called, *The Society for the Mines Royal*, as having the Grant and Care of all Gold and Silver Mines, &c. within the eight Counties before recited, (x). and all *Wales*

King *James I.* in the *second* Year of his Reign, by his *Letters Patents*, granted all Mines and Ores (formerly granted by the Queen) to *William Earl of Pembroke, Robert Viscount Cranbarn, Henry Lord Windsor, Thomas Lord Burleigh, Thomas Lord Gerard, Sir John Popham Knight, Sir John Smith Knight, Sir Roger Owen Knight, &c.* and all Immunities formerly granted, and incorporates them again by the Name of, *The Governours, Assistants and Society of the City of London, of and for the Mines-Royal*, and by that Name to have Succession, and to continue for ever. He granted them likewise some additional Powers which they had not before (y.)

After the Death of *William Earl of Pembroke, Philip Earl of Pembroke and Montgomery* was chosen Governour of the Society; and in the Reign of *King Charles I.* about the Year 1639. there was some Dispute betwixt *Sir Hugh Middleton* and *Sir Richard Price*, con-

(x) *Fodin. Regal.* p. 21. (y) *ibid.* p. 24.

cerning the Mines at *Tallabout* in *Wales*, whether *Royal* or *not Royal*. But several eminent Lawyers subscribing their Opinions (hereafter set down) that matter was quieted. Then from the year 1641 to 1647 no Governour was chosen, but the Mines in *Wales* continued working under Mr. *Thomas Busbel*, who made them very serviceable to the martial concerns of the King during the Civil Wars.

Philip Earl of *Pembroke* being dead, his Son *Philip* was in the year 1649 chosen Governour of the *Society*, and in 1662 the Lord *Anthony Ashley Cooper* (afterward Earl of *Shaftsbury*) Chancellor of the *Exchequer* and Privy-Councillour to King *Charles II.* was joyned with him. But in the year 1668 the Earl of *Pembroke* being willing to quit his place in respect of his retirement from Court, his Highness *Prince Rupert*, Duke of *Bavaria* and *Cumberland*, was chosen together with the Lord *Ashley Cooper*, Governour of the *Society*.

The Deputy Governours of this *Society* in the year 1670 were, the Lord *Brunker*, Sir *Robert Murray*, Sir *John Pettus*, Sir *Francis Cobb*, Coll. *Ashburnham* Cofferer to his Majesty, *Thomas Foley Esq;* *Edward Smith Esq;* and *Edward Henshaw Esq;*.

The Earl of *Shaftsbury* retired into *Holland* in the year 1681, and there dyed. *Prince Rupert* also departed this Life Nov. 29. 1682. After his death the Right Honourable *George* Marquess of *Hallifax* (and at that time Lord

Privy-

Privy-Seal) was chosen Governour of the *Society of the Mines Royal*. But he also left this World in the latter end of *August* in the year 1700. I cannot find who succeeded him as Governour, nor who are the present Members of this Society, nor indeed whether there be any, tho' I have diligently endeavoured it; neither can I as yet discover in whose Hands the *Records* do now remain, that belong to it, which were in Mr. *Kemps* keeping of the *Inner-Temple* in the year 1670, who was Register to the Society. It is supposed that the Members of this Society are all extinct or totally discouraged by the late Act of *Royal Mines*, which by setting so high a price on the pre-emption of all sorts of Ores, has in effect ruined that Society and destroyed that undertaking.

The two Societies of *Mines-Royal* and *Mineral Works* had in the year 1670 the same Governour, Deputy-Governours, and Assistants, the one as the other, for the better intercourse between them in such publick concerns, and did then both agree to and publish the following *Rules* concerning the letting of *Leases* to Owners, Discoverers, or Undertakers of such Mines, as hold Gold or Silver, which how well they have been observed, you may see at large in the latter end of the next Chapter. [1.] as to themselves the *Lessors*.

(1.) They covenant and agree, that if any Owner or Proprietor do discover any *Mines*

Royal in his Ground, he shall have as many Leases as he pleaseth, he covenanting for every Lease according to Conditions under-written.

(2.) If any Farmer or Possessor do discover a *Mine-Royal* in the Land which he useth, which was never wrought, he shall have the *Moiety* of the Profits, and the Proprietor the other *Moiety*, if they will joyntly work, and in that case a Lease shall be made to both of them, but if the Proprietor do refuse to joyn in such Lease, then the Lease to be to the Discoverer, he covenanting as followeth; but if both shall Refuse, or forbear to work through *disability* or *unskilfulness*, then the Corporation will reward the Discoverer, according to the Nature of the Mine, whether he be Proprietor, or otherwise.

(3.) If any Farmer or Possessor discover a *Mine-Royal*, which hath been wrought otherwise then as a *Mine-Royal*, he shall be proceeded with according to the second Rule.

(4.) If any other Person, being neither Owner, Possessor nor Farmer, shall discover a *Mine-Royal* in another Man's Ground, he shall be proceeded with according to the second Rule.

(5.) A Discoverer, who shall be capable of a Lease in another Man's Ground, is such a Person, as shall be the *first*, who without Fraud or Circumvention shall inform the Corporation of it.

(6.) If

(6.) If any Person shall undertake to work a *Mine-Royal*, that hath been long deserted by reason of Water, or other causes hindring the Work, the Owner refusing to work or joyn in the same, such Undertaker shall have all reasonable encouragement from the Corporation, by Lease or otherwise.

(7.) The Term to be granted in any Lease not to exceed the Term of forty and one years.

(8.) The Lessee shall have Power to dig and search for *Mines-Royal* in any Man's Ground whatever, in as full manner, as is granted by the *Charter*, provided he dig not under any *Castles* or *Houses*, nor in any *Gardens* or *Orchards*, without the Proprietors consent.

(9.) The Grounds and Mines to be Leased (by any one single Lease) shall not exceed one Mile in Diameter.

(10.) If the Lessee shall drive a Mine into another Man's Propriety without the limit of *that* Mile, then upon the Lessee's taking of a new Lease, consideration shall be had of the Proprietor, as the *Company* shall think fit, it being not reasonable, that he be admitted to the entire advantage of the second Rule.

(11.) That the *Fine* to be paid upon every Lease granted, be at least equal to a Years-Rent reserved.

[2.] As to the *Lessee's*.

(1.) The Lessee is to pay the reserved yearly Rent at the time and place appointed, by two equal Portions.

(2.) To discharge all Dues to the King, and save the *Company* harmless, and to give an account to the Company, when required, how the King Dues are answered, and what Metal the Mine affordeth.

(3.) Not to dig under any Castles or Houses of the King or his Subjects, nor in any Gardens or Orchards without consent of the Owners.

(4.) The Lessee to covenant further, immediately to set in hand, proceed and continue the effectual working of the Mines or Mineral Works demised.

(5.) A Proviso that the Lessee may Surrender his Lease, after six Months Advertisement to the Company, paying all Arrears.

(6.) Damages for breaking Ground to be referred to six indifferent Persons according to the *Patent*.

(7.) That every Lessee shall bring in all his Gold and Silver into the Kings Mint to be coin'd, or otherwise forfeit the same or the full value thereof.

(8.) The Lessee to extract the Gold and Silver out of the base Metal, as long as it containeth so much of both, or either of them, as will countervail the charge of extracting; and the loss of the base Metal, or else shall forfeit his Lease.

(9.) The

(9.) The Lessee not to assign his Lease, or make any Lease out of it, without licence from the Corporation.

(10.) The Lessee, at the end of the Term, or other Determination, to deliver quiet Possession without prejudice to the Mine.

(11.) The Corporation to covenant for quiet Possession against them, and all others claiming under them, *Fodin. Regal.* p. 77. & 78.

C H A P. III.

Shewing what the Law is at this Day concerning Royal-Mines.

THE Subjects of the Crown of England have in the last Century put restraints upon the *Prerogative* in many things, or rather the *Crown* has thought fit to make *Concessions* and *limit* it self in many particulars relating to the *Liberties* and *Properties* of the *Subject*; an instance whereof we have in the case of *Mines*, which *anciently* belonged to the *Crown*, whether they were of *Gold*, *Silver*, *Copper*, *Lead*, *Allum*, &c. But now the *common Law* of *England* fixes and settles the *Right* and *Title* of all *Mines* of *Basfer Metals*, as *Copper*, *Lead*, *Iron*, &c. in the *Owner* of the *Soil*, where they grow, and the *Crown* claims *only Gold* and *Silver-Mines*; those only at this time being properly

properly called *Royal Mines*; concerning which the Law was lately this, viz.

Where the Ore digged from any Mine doth yield, according to the Rules of Art, so much Gold or Silver, as that the value thereof exceed the charges of refining, and loss of the baser Metal, in which it is contain'd, and from whence it is extracted, then it is called a *Mine-Royal*, and appertains and belongs to the Crown by virtue of the Prerogative (a). Or, if you please, take it in the Words of fifteen eminent persons learned in the Laws, who subscribed their Opinion and Judgment in this Case, in the 16th Year of King Charles I. February 9, 1640, as follows.

Altho' the Gold or Silver contained in the base Metal of a Mine in the Lands of a Subject, be of less value than the base Metal; yet if the Gold or Silver do countervail the charge of refining it, or be of more worth than the base Metal spent in refining it: This is a *Mine-Royal*, and as well the base Metal, as the Gold and Silver in it, belong to the Prerogative of the Crown.

Subscribed by

John Glanvil, E. Herbert, Ralph Whitfield, Oliver St. John, John Hern, Christ. Fullwood, Harbottle Grimston, Edw. Bagshaw, John White, John Glover, Ja. Howard, Eus. Andrews. Edw. Prideaux, John Maynard, Tho. Culpeper (b).

(a) *Footma Regales*, l. 9. (b) *ibid.* l. 75.

But notwithstanding this plain definition of a *Mine-Royal*, which one would think to be sufficient to prevent all Controversies and Disputes about that matter, yet there has hardly been any thing more contested. One Reason hereof was, that this matter depended very much upon the Skill and Honesty of the Refiners; some having made very great Products from that very Ore, from which less skilful *Affayers* could extract nothing. A fresh instance hereof we have in the famous Mines of Sir *Carbery Price* at *Est-kyr-kyr* in *Cardiganshire*, which were discovered in the Year 1690. A considerable quantity of *Silver* being found mixed with the *Lead*, the *King*, or the *Patentees* of *Royal Mines*, laid claim to them. Hereupon there ensued several great and solemn Tryals at Bar in *Westminster-Hall*; which were chiefly occasioned by the different Reports that were made concerning the value of the *Silver* extracted from the *Lead*, which was taken out of the said Mines; an account whereof you have from that worthy and publick-spirited Gentleman, Sir *Humphry Mackworth*, in his *Mine-Adventure Expedient* (c), in these Words.

‘ As to the *Silver*, it’s well known, that at the
 ‘ Tryals at *Westminster-hall*, different Proofs were
 ‘ made of the value thereof, from 60 *l.* per Tun
 ‘ of Metal to 3 *l.* or 4 *l.* per Tun; which occa-

' sioned very great censure of Perjury on one
 ' side or other. But though I will not take
 ' upon me to judge of that matter, being not
 ' present at the Tryal, yet from the Experience
 ' I have had of Mines, I am charitably incli-
 ' ned to believe it possible, that all those dif-
 ' ferent Oaths may be consistent. For I am
 ' informed the proof lay thus. The Extractor
 ' or Refiner swore, that he received a parcel
 ' of Ore from (A), which yielded Silver at the
 ' rate of 60 *l.* in a Tun of Metal. (A) swore,
 ' he had that parcel of Ore out of the Mines
 ' of Sir Carbery Price. Another Extractor
 ' swore, he had a parcel of Ore from (B),
 ' which yielded but 4 *l.* per Tun; and (B)
 ' swore, he had that parcel of Ore from the
 ' same Mines. And all this might be true;
 ' for 'tis certain, that in most *Veins* there be
 ' be small Ribs and Knots of Ore vastly richer
 ' than the other parts thereof: And (A)
 ' might pick choice pieces for the King or Pa-
 ' tentees, and (B) the worst he could meet with
 ' near the Surface of the Ground for Sir Car-
 ' bery Price.

From hence you see, what was the chief
 cause and occasion of so many *Disputes* and
Law-suits about *Royal Mines*.

After Sir Carbery Price had recovered his
 Right, by virtue of several *Verdicts* given for
 him against the Crown in *Westminster-Hall* (the
 last of them by a *Jury* of *Hertfordshire Gentle-*
men, after a very long and solemn Tryal,) or
 rather

rather after K. *William* had granted a *Noli Prosequi*, which put a stop to any further proceedings against Sir *Carbery Price*, and left him in the quiet possession of his Mines, the *Parliament* took this matter into consideration, and passed the following *Act* for the *Quiet* of the Subject. For they had observed with what *warmth* and *vigour* the Prosecution was driven on against that Gentleman by the *Court*, many of the *Nobility* and *Great Officers* of the Crown being present in the *Exchequer-Court* all the time of the last *Trial*, which held twenty-four Hours, at that *Bar*; it being commonly reported, that *Henry* Lord *Capel* had a promise of the *Grant* of those Mines, if they had proved *Royal*. However that was, this is certain, that Sir *Carbery Price's* Concern and Title to those Mines, was the first occasion of this *Act* of *Parliament* concerning *Royal Mines*; which in all probability will redound to the great advantage, not only of private Proprietors and Owners of Mines, but also of the *Crown* and these *Kingdoms*, by promoting the discovery of more Mines, and thereby advancing the *Trade*, *Customs*, *Manufactures*, *Wealth* and *Strength* of them.

Anno Quinto Gulielmi & Mariae.

An ACT to prevent Disputes and Controversies concerning Royal Mines.

WHereas by a Clause in one Act of Parliament made in the first Year of their Majesties Reign, Entituled, An Act to repeal the Statute made in the fifth Year of King Henry the Fourth, against the multiplying of Gold and Silver; It is, amongst other things Enacted, that no Mine of Tin, Copper, Iron or Lead, shall hereafter be adjudged, reputed or taken to be a Royal Mine, although Gold or Silver may be extracted out of the same: But, notwithstanding the good Provision by that Statute, to prevent the discouraging their Majesties good Subjects, who have Mines of Copper, Tin, Iron or Lead in their Soils, from digging and opening the same, many Doubts and Questions have arisen upon the said Statute, whereby great Suits and Troubles have arisen to many Owners and Proprietors of such Mines.

Wherefore, for the better Explanation of the said Statute, Be it enacted and declared by the King and Queen's Most Excellent Majesties, by, and with the Advice and Consent of the Lords Spiritual and Temporal, and the Commons in the present Parliament Assembled; and by the Authority of the same,
That

That all and every Person or Persons, being Subjects of the Crown of England, Bodies Politick or Corporate, that now are, or hereafter shall be the Owner or Owners, Proprietor or Proprietors of any Mine or Mines, within the Kingdom of England, Dominion of Wales, or Town of Berwick upon Tweed, wherein any Ore now is, or hereafter shall be discovered, opened found or wrought; and in which there is Copper, Tin, Iron or Lead, shall, and may hold and enjoy the same Mine or Mines and Ore, and continue in the Possession thereof, and dig and work the said Mine or Mines or Ore, notwithstanding that such Mine or Mines or Ore shall be pretended or claimed to be a Royal Mine or Royal Mines; any Law, Usage, or Custom to the contrary notwithstanding.

Provided always, and be it enacted and declared, that their Majesties, their Heirs and Successors, and all claiming any Royal Mines under them, shall and may have the Ore of any such Mine or Mines in any part of the said Kingdom of England, Dominion of Wales, or Town of Berwick upon Tweed (other then Tin Ore in the Counties of Devon and Cornwall) paying to the Proprietors or Owners of the said Mine or Mines, whetein such Ore is or shall be found, within thirty Days after the said Ore is or shall be raised and laid upon the Banks of the said Mine or Mines; and before the same be removed from thence the Rates following (that is to say) for all Ore washed, made clean and merchantable, wherein is Copper,

the rate of sixteen Pounds per Tun : And for all Ore wash'd, made clean and merchantable, wherein there is Tin, the rate of forty Shillings per Tun ; and for all Ore wash'd, made clean and merchantable, wherein there is Iron, the rate of forty Shillings per Tun ; and for all Ore wash'd, made clean and merchantable, wherein there is Lead, the rate of nine Pounds per Tun ; and in default of Payment of such respective Sums, as aforesaid, it shall, and may be lawful for the Owners and Proprietors of the said Mine or Mines, wherein such Ore is, are, or shall be found, to sell and dispose of the said Ore to his and their own Uses ; any Law, Statute, or Custom to the contrary notwithstanding.

Provided always, that nothing contained in this Act shall alter, determine or make void the Charters granted to the Miners of Devon and Cornwall, by any of the Kings and Queens of this Realm, or any of the Liberties, Privileges or Franchises of the said Miners, or to alter, determine, or make void the Laws, Customs or Constitutions of the Stannary's of Devon or Cornwall, or any of them.

This Act, 'tis hoped, will not only prevent *Disputes* and *Law-suits* for the future concerning *Royal Mines*, but also, as was said before, be of great advantage both to *the Crown* and to *the Subject*. For, 'tis plain, the Crown had little or no Benefit from *Royal Mines*, before this Act was made : No, they were generally
granted

granted away under a small Duty to the King; which was seldom or never paid; and the *Patentees* of them could never agree to raise any great Stock to carry on the Works, and were always opposed by all the Proprietors of the Lands where the Mines lay, in every County, so that they could make no considerable matter of them (d).

But *now* when every Proprietor will make a very considerable advantage by any Mines found in his Soil, every one will be industrious to discover them; and there is no doubt but from this encouragement, there will in a few Years be so many and so good ones discovered, that the *Queen* will get more by the very Customs of *base Metals*, than all the *Kings* and *Queens* of *England* have got by Royal Mines before. So that this Act of *Royal Mines* has quite altered the *Scene* of the Mineral World; for *before* every one, that had an Estate or Interest in his Country, endeavoured to conceal their Mines; but *now* they all labour to find them out (e): And *formerly*, if they found a Vein of Ore, that did contain so much Silver, as would make it a *Mine-Royal*, they would not let it be known, or else they would presently beat it, and mix it with their softer and baser Ore, pretending the one would not melt without the other;

(d) Familiar Discourse of the Mine-Adventure, p. 94. (e) *Ibid.* p. 95.

this being with them a common Trick, lest their work should be taken from them (f).

But the Case being now altered, it is not unlikely but some time or other one of these concealed Mines, or some other may be found out, and prove so rich in Silver, as may be worth Her Majesties acceptance at the price proposed in the *Act* aforesaid (g).

The People of *England* did so very much oppose the *Patentees* and *Society for Royal-Mines*, and endeavoured to conceal their Mines, or took but little or no pains to find them, because the *Proprietors* thereof were to have no advantage by them, if they should prove *Royal*, nor the least share of the Profit, as one assures us (h); for though we find in many of the *Grants* made by the *Crown* of *Royal* and other Mines, a *Clause* to oblige the *Grantees* or *Patentees* to make recompence to the *Proprietor* of the Soil for all damage done to it: Yet this was little regarded; Mens Lands being torn up to the very Bowels, and covered with Heaps of Rubbish, and High-ways made over their Corn and Pasture Land, without paying any consideration for the same, to the great Grievance and Oppression of the Subject (i). No wonder then that the *Society* or *Patentees* of *Royal-Mines* could make no great Profit, when it was the Interest of all the Country to oppose them, and the Miners

(f) *Metallographia*, p. 22.

(h) *ibid.* (1) p. 96. 97.

(g) *Familiar Discourse*, p. 95.

and the Country People made them pay very dear for every particular thing : For the People of *England* were always averse, and ever will be, to the least Intrusion into their Properties, and to the damnifying their Estates by any Person or Persons whatsoever.

The *Patentees* came into Mens Lands with great Power and Authority, and without asking leave, seized upon a Mine, that in bringing it to Perfection, had perhaps almost ruined the Proprietors Estate (*k*).

But now by the *late Act*, every Man is at liberty to work, or not to work, his Mines, as he thinks fit, or to call in others to his assistance, and to have a valuable consideration for his Ore, if the *Crown* or *Patentees* lay claim to it.

All those rich Mines in *Cardiganshire*, which are now working, and from whence great quantities of Silver are daily extracted, had been lost to the *Nation*, if the foregoing *Act of Royal Mines* had not encouraged Proprietors and Adventurers to try their Fortunes in such Undertakings (*l*).

I will only take notice, in the conclusion of this Chapter, of one thing, which seems to have been a discouragement to the *Society* or *Patentees* of *Royal Mines*; which is, that in all the *Grants* from the *Crown* of such Mines, there was always a *Clause* or *Proviso* incerted,

(*k*) *ibid.* (*l*) The second Familiar Discourse of the Mine-Adventure, p. 32.

by which the *Crown* left it self the liberty of *resuming* those *Grants*, whenever it should be thought fit. Thus *Queen Elizabeth* resumed the *Grants* she had made to *Houghsetter* and *Thurland*, to *Humphrey* and *Shutz*; and even in the *Charter* of the *Corporation* or *Society* for *Royal Mines*, she reserved to her self and her *SUCCESSORS*, a *Power* at any time to reassume the management of those *Affairs*, paying to the *Society* such *Compensation* as should be indifferently awarded (*m*). One reason given for this *Clause* of *Reservation* was, that if the *Patentee* or *Patentees* should happen to make any rich *Discovery*, and thereby the benefit of the *Mines* be in danger of exceeding the bounds of a *Subjects* *Fortune*, the *Crown* might prevent it, and reap all the advantages it self; for the *Crown* can never be too rich (*n*).

C H A P. IV.

Of the Art of Extracting Gold and Silver from baser Metal.

SIR *Henry Spelman* tells us (*a*), that the *Treasure* of this *Kingdom* has been encreased by the *Gold* and *Silver* try'd and drawn out of our own *Mines*; which tho it be but little

(*m*) Sir *John Petrus's* *Hodm. Regal.* p. 29. (*n*) *ibid.* (*a*) in his *Remains*, in the *Dialogue* concerning the *Coin*, p. 210.

in respect to what in this latter Age has been brought from the *West-Indies*; yet it is so much, as our *Histōriographers*, both *ancient* and *modern*, have thought worth the noting. And all our Kings from time to time have made especial Account of, as well appeareth by a multitude of Leases thereof granted by them to many noble Persons, extant in the *Chequer-Records*.

And the famous Lord *Bacon* did long since deplore the loss of so many *Millions* of *Bullion*, as have from time to time been exported out of *England* in our native *Lead*, merely for want of Skill and Stock to carry on so great and noble an Undertaking, as is the extracting of *Silver* out of great Quantities of *Lead* (b).

Indeed we have not yet discover'd in *England*, any Mines, which yield *pure* and *perfect* *Gold* or *Silver*, as they have in other Countries: But our former and latter Ages have, and yet do, get *Gold* and *Silver* by *Extraction*, or by melting the *baser* Metals after such a manner, as by the *Art* of the *Refiner* the *Gold* and *Silver* is separated from them (c). But the way of separating them from other Metals, has been but little known or practised in this Kingdom, and seems to have been better understood in *Holland*; where (we are told (d)) they can separate the *Silver* from the

(b) The Nine-Adventurers Proposal, p. 4. (c) *Fodin. Re*
gal. p. 3. (d) *MetaUographia*, p. 233.

Lead, and in a *Tun* not lose above two hundred weight of Lead; and that if the Lead held above *five* pounds of Silver in a *Tun*, they would separate them with the charge of *fifty* Shillings, and make gain by it; and to that end they buy much of our *English* Lead and refine it. We are assured by a very good Author (e). that the Art of *extracting* and *refining* is much improved of late Years among us; though it would be a most valuable and advantageous thing to this Nation, if the Art of Extraction were brought to its highest Perfection. The same Author tells us, that *The Governour and Company of the Mine Adventurers* have made the fairest step towards it by the Aid and Ingenuity of Mr. *Lyddall*; for it is certain, they have refined that Ore to great Advantage, which some of the greatest Artists in the Kingdom could make no Profit of: Every *Refining Furnace*, of which they have many, making about *eighty* Ounces of Silver per Week (f).

The common way of extracting *Gold* or *Silver* from other Metals, is either by *Fire* or by *Quick-silver*: The manner of doing it by *Fire* see in Dr. *Fritschius's Pyrotechnical Metallurgy*, page 185, &c.

In *America* the usual way is to separate the Silver from the Ore by *Quick-silver* or *Mercury*. The Silver will *Amalgamate* (as the *Chymists*

(e) Familiar Discourse, p. 129. (f) The second Discourse of the Mine-Adventure, p. 30.

speak) with the Mercury, and so make a *Paste*,
 which gives the Refiner all the Silver. Of the
 manner of doing it, take the following short
 Account from Monsieur *Acarete* (g): They
 first beat the Ore well upon Anvils with cer-
 tain great Hammers, which a Mill continually
 keeps at work: When the Ore is pretty well
 reduced to powder, they pass it thro' a fine
 Sieve, and spread it upon the Ground about
 half a foot thick in a square place, that is ve-
 ry smooth, prepared for the purpose; then
 they cast a great deal of Water upon it: Af-
 ter which, with a Sieve, they spread upon it
 a certain Quantity of Quick-silver, which is
 proportioned by the Officers of the *Mint*, and
 also a Liquid Substance of *Iron* (h). The Ore
 being thus prepared, they stir it about and
 mix it, as Men do when they make Mortar,
 for a Fortnight together, every Day tempe-
 ring it with Water: After this they several
 times put it into a Tub, wherein there is a lit-
 tle Mill, which by its motion separates from
 it all the Earth with the Water, and casts them
 off together; so that nothing but the *Metal-
 lick Matter* remains at the bottom, which is
 afterwards put into the Fire in Crucibles, to se-
 parate the Quick-silver from it, which is done
 by *evaporation*. But as for the Iron-Substance,

(g) In his late Voyage to Peru, and Description of the Mines
 of *Potosi* p. 52. (h) The Iron-Substance is mixed with the
 Quick silver to cleanse it, and make it the better take hold of and
 gather the Silver together. *Barba's Art of Metals*. p. 39.

that does not evaporate, but remains mix'd with the Silver; which is the reason, that there is always in *eight* Ounces of Silver (for Example sake) *three quarters* of an Ounce, or thereabouts of *false Alloy*; The Silver, when thus refined is carried to the Mint, and melted into Bars or converted into Money.

Whoever desires to see a more particular and large Account of this matter, may find it in *Barba's* second Book of *the Art of Metals*, and *Dr. Gamelli's Account of New-Spain*, p. 539, where he may also see the way of separating Silver from Stone (with which it is sometimes mixed) by Fire. There being some Gold mixed with the Silver of the Mines of *New-Spain*; if the Silver contains above *forty* Grains of Gold in a *Mark*, they separate them after this manner, viz. the *mixed* Metal being melted is converted into little Balls, which are put into Vessels with *Aqua-fortis* to dissolve: The Gold remains at the bottom of the Vessel like black Powder; and the *Aqua-fortis* containing the Silver is put into two Glasses, with their Mouths together; putting Fire to it, the Silver remains in one of the two Glasses, and the *Aqua-fortis* in the other, the Gold is run in a Furnace and cast into Ingots (i).

If Silver is mixed with Copper, *Aqua-fortis* will part them, if with Lead, *Cuppel* or *Coppel*: For it is certain, that *Aqua-fortis* will dissolve

(i) Collection of Voyages, Vol 4. p. 529.

all other Metals; but Gold; and that *Aqua-Regia* will dissolve Gold, but no other Metal (*k*).

One, who is thought to understand *the Art of Extraction* very well, tells the World (*l*), that it is a *vulgar Error*; that, when the Silver is extracted from the Lead, the Lead is spoiled and good for nothing; for 'tis found by Experience, that the Lead is *the better*; and it agrees with the general Rule in all Cases of Metals, that the oftner its refined in the Fire, the *purser* the Metal; though he grants indeed, that the more Lead you refine, the less will be your Quantities of Lead, which wastes near a fifth part of your Operation, when the *Lytharge* is reduced into Lead again (*m*). One great difficulty in the Art of extracting is occasioned by the *Sulphur*; of which there is more or less in *all* Metals, and very much in some of them; for Sulphur is a great Enemy to Silver, and being melted together with it in the Fire destroys the very Body of it, as you may observe by the common Experiment of flitting a *Groat* with Sulphur or Brimstone set on fire upon it, which will turn the Silver-Groat into a black Dust, which can never by any Art be reduced into Silver again: So that Silver-Ore abounding with Sulphur, in smelting of it in the Fire, the Sulphur destroys a

(*k*) *Cler. Physic. lib. 2. c. 4.* (*l*) In the Familiar Discourse of the Mine-Adventure, p. 36 & 37. (*m*) The second Familiar Discourse of the Mine-Adventure, p. 35.

great part of the Silver, sometimes *more*, sometimes *less*, according to the skill and care of the Smelter. But to prevent this, some Operators use such a *Flux* in *smelting* the Ore, as either imbibes, fixes or destroys the strength of the Sulphur, before it has any great operation on the Body of the Silver; which *Flux* is not commonly known; and where it is, there is skill and care in the very use and application thereof, and in the ways and proper seasons of mixing and stirring the Ore and Flux (which is a Compound) together: And this is the reason, that we have sometimes *more* Silver, and sometimes *less*, out of the same quantity of Metal, and of the same goodness (n).

Now there be great Variety of *Flux-powders* or *Fondants*, as the *French* call them, which are prepared to facilitate the Fusion of the harder Metals, and to melt Ores, in order to discover what proportion of Metal they hold or contain. Powder of *Antimony* alone is in many Cases a very good *Flux*, and with it you may readily melt *Iron* or *Steel* in a crucible with an ordinary Charcoal-fire. Mr. Boyle gives an account of a Powder he used, which was composed of *Tartar*, *Sulphur* and *Arsenick*.

The *Cuppel* or *Coppel* before-mentioned (which by the Refiners is usually called *the Test*) is an Instrument in *Chymistry* in the form

(n) The Familiar Discourse, p. 37.

of a Dish made of Ashes well-washed, to cleanse them from all their Salt, or of Bones thoroughly calcined. Its use, as was said, is to separate Silver from Lead; which is done by exposing the mixed Metal in the *Coppel* to a violent Fire a great while; by this means the Lead will be parted from the Silver and carried off to the sides of the *Coppel* (o).

Thus we are told by an ingenious Gentleman and great Traveller (p), that at the Mines in *Hungary*, the Lead or what else remains mix'd with the Silver, is driven off in the Furnace by the blowing of a pair of great Bellows; and runs over from the melted Silver in form of *Lytharge*: (That which first comes over is the *white*, and that which comes last being longer in the Fire is the *red*; not that it is *Lytharge of Gold*, both being driven off from the same Metal.) When all the Lead is evaporated or driven off in *Lytharge*, the Silver will have a *bright* Aspect like a Looking-glass, and will be suddenly changed into a *burning*, and as it were, *red-hot* form, whence it is said to *lighten*, which *Phænomenon* is accounted a sign of the *Cuppellation's* being finished, and of the Leads being now consumed or cast off, with the rest of the *Heterogeneous* Metallick Particles (q).

(o) *Lexicon Technicum* (p) Dr. Brown in his Travels to *Hungary*, p. 92. (q) Dr. *Fritschius's* Principles of Pyrotechnical Metallurgy, p. 227.

The way to make *hard* and *brittle* Silver *smooth* and *fine*, and to separate *Tin*, *Iron* or *Steel* from Silver: See in *Lazarus Erckern of Ores and Mineral Bodies*, Book I. Ch. 27, 31, 32. as also the *Hydrostatical* way of proving, whether Silver contain in it any Gold, B. 2. c. 18.

I shewed before the way of separating Gold from Silver by *Aqua-fortis*; for thus, most of the Silver-Ore at *Schemnitz* in *Hungary* holding some Gold, they separate it by melting the Silver, then granulating it, and afterwards dissolving it in *Aqua-fortis*, made out of a peculiar *Vitriol*, prepared at *Chremnitz*; by which means the Gold is left at the bottom, and afterwards melted: The *Aqua-fortis* is distilled from the Silver, and serves again for use (r).

CH A P. V.

Of the great Benefit of this Art to the Publick, and the Act of Parliament for the encouragement of it.

AS to the benefit of this Art of Extraction to the Nation, 'tis very plain, that how little Profit soever the *Extractor* may make to himself, or to those that employ him, all the Silver extracted is clear Gain to the Publick.

So that in case you extract no more than 5 *l.* of Silver out of a Tun of Lead, and the charge of doing it should amount to 4 *l.* 10 *s.* 00 *d.*, whereby your Profit is no more than 10 *s.* in a Tun, which is very inconsiderable; yet the Nation will gain the whole *five Pounds*, which is considerable, and may amount to a vast Revenue, if there be encouragement to extract the Silver out of great quantities of Ore (a).

An old Act of Parliament having been a great discouragement to this *Art of Extraction*, it was repealed in the following Words.

Anno Primo Gulielmi & Mariæ.

An A C T to repeal the Statute made in the Fifth Year of King Henry the Fourth, against the Multiplying Gold and Silver.

W Hereas by a Statute made and enacted in the Parliament held in the fifth Year of the Reigh of King Henry the Fourth, late King of England; it was amongst other Things enacted in these Words, or to this effect, namely, That none from henceforth should use to multiply Gold or Silver, or use the Craft of Multipli-

(a) Familiar Discourse of the Mine Adventure, p. 130.
cation.

cation, and if any the same do, they shall incur the pain of Felony. And whereas since the making of the said Statute, divers Persons have by their Study, Industry and Learning arrived to great Skill and Perfection in the Art of Melting and Refining of Metals, and otherwise improving them and their Mines (which very much abound within this Realm) and extracting Gold and Silver out of the same: But dare not exercise their said Skill within this Realm, for fear of falling under the Penalty of the said Statute, but exercise their said Art in Foreign Parts to the great Loss and Detriment of this Realm.

Be it therefore enacted by the King and Queens most Excellent Majesties, by, and with the Advice and Consent of the Lords Spiritual and Temporal, and Commons in this present Parliament Assembled, That from henceforth, the aforesaid Branch, Article, or Sentence, contained in the said Act; and every Word, Matter, and Thing, contained in the said Branch or Sentence, shall be repealed, annulled, revoked, and for ever made void, any thing in the said Act to the contrary in any wise notwithstanding.

Provided always, and be it enacted by the Authority aforesaid, that all the Gold and Silver, that shall be extracted by the aforesaid Art of Melting and Refining of Metals, and otherwise improving them and their Mines, as before set forth, be from henceforth employed for no other Use or Uses whatsoever, but for the increase of Monies; and that the Place hereby appointed for the disposal thereof, shall be their Majesties

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mint within the Tower of London; at which place they are to receive the full and true value of their Gold and Silver, so extracted from time to time, according to the Allay and Fineness thereof; and so for any greater or lesser weight: And that none of that Metal of Gold and Silver, so refined and extracted, be permitted to be used or disposed in other Place or Places within their Majesties Kingdoms and Dominions.

C H A P. VI.

Of the Purification of Gold and Silver.

THERE be several ways to *purifie* Gold, as by *Aqua-Regis*, by *Cementation*, by the *Depart*, and by *Antimony*.

By *Aqua-Regis* thus: Take the Gold, and cut it into small Plates and beat them thin; then put it into a good and well-luted Glass-Bottle, and pour upon it the *Aqua-Regis*, which will dissolve all the Gold: What lies at the bottom and is not dissolved, is some other Metal; for *Aqua-Regis* toucheth nothing but Gold. Pour the *Aqua-Regis*, in which the dissolved Gold is, clean off, and put it into another Glass-Bottle, and draw the *Aqua-Regis* from the Gold, and melt and cast the Gold into Ingots (a).

(a) *Lazarus Eyckern* of Ores and Mineral Bodies, Book 2. chap. 32.

By *Cementation* thus : Stratifie in a Crucible thin Plates of *Gold* and *Cement* (i.e. the Past of that name, which is made of one part of *Sal-Armoniack*, two parts of *Sal-Gemme*, and four parts of *Potters-Earth*, or powder'd Brick) and covering the Crucible, make a violent Fire round about it, to calcine the matter for ten or twelve hours, that the corroding Salts may carry off the impurities of the Gold. But this Purification is by no means so good as that made with *Antimony*, for these Salts do sometimes leave other Metals remaining with the Gold, and besides do often eat away the very Gold it self (b).

By the *Depart*, (so called, because the Particles of Silver are made by it to depart from Gold, when they were before melted together in the same Mass, and could not be separated any other way) after this manner.

Melt the united Metals together in a Crucible with a strong Fire, and while the Matter is in fusion cast it into a Vessel of cold Water: The Mixture will be divided into very small Grains; which being collected again, and having *Aqua-fortis* poured on them, that *Menstruum* will dissolve the Silver: but leave the Gold at the bottom in a Powder; which after the Solution of the Silver is gently poured off, must be washed to sweeten it. This is intended for a kind of purification of Gold; but all

(b) Mr. Harris's *Lexicon Technicum*.

he Particles of Silver will scarce be separated from it even this way : The only way to purifie Gold exactly is by *Antimony* (c).

Here note, that you must cast the aforesaid mixed Metal *drop by drop* into the cold Water, to make it *granulate* and congeal into small Grains, though some think the best way is to pour the Metal through an Iron-Cullender or a new Birchen-Broom. Note also, that the way to dulcifie or sweeten the Gold-Calx or Powder is this : Put it into clean boyling hot Water (Rain-water is best ;) let the Water go well over the Gold and boyl well ; then put the Water off, and put in more clean Water, and boil it again : do this till the Water goes off from the Gold very *clean* and *clear*, and has no *sharpness* in it (d).

If you would pursue the foresaid *Depart* farther and get your *Silver* out of the *Aqua-fortis*, put then into an Earthen Pan a Plate of Copper, and on it pour ten or twelve times as much Water as the quantity of your impregnated *Aqua-fortis* ; into which put in the *Menstruum* or *Aqua-fortis*, and let the mixture lie still for some Hours, or till you find the Copper-plate to be covered all about with the Powder or Precipitate of Silver, and that the Water begins to turn blue ; then filtrate the bluish Water : And this is that which is call'd *Aqua-secunda*. Dry the Powder of Silver and melt

(c) *Idem ibid.* (d) L. Erckern, Book 2. chap. 32, p. 181.

it into an Ingot in a Crucible with a little Salt-Peter.

If you steep a Plate of Iron some Hours in this *Aqua-Secunda*, you will have another *Depart*; for the *Menstruum* will let go the Copper, which it had dissolved, and which made it look blue, to prey upon the Iron, and you will have your Copper in Powder on the Iron Plate.

And if you filtrate this dissolution, you may get the Iron out of it, by laying in it a piece of *Lapis Calaminaris*, the Iron will depart out and fall to the bottom in a Powder, and the Stone will be dissolved, or at least as much of it as the *Menstruum* can contain.

If you again filtrate this Water, and then pour upon it drop by drop the *Liquor of fix'd Nitre*, the *Lapis Calaminaris* will be precipitated to the bottom. And lastly, if you filtrate this Water, as before, and after having evaporated a part of it, set the rest in a cold place, you will have Chrystial of Salt-peter, which will burn like the ordinary sort.

Note, that though the Silver, the Copper and the Iron, could not be gotten perfectly out of the *Menstruum*, yet the *Liquor of fix'd Nitre*, will precipitate all the *Lapis Calaminaris*, and the remaining Particles of the Silver, Copper and Iron (e).

If you would precipitate the Silver, that is dissolved in *Aqua-fortis*, and whose Particles

(e) *Lexicon Technicum.*

are kept suspended in the *Menstruum*, without putting any other Metal into the *Menstruum*, which it can more easily dissolve, some Oyl of *Tartar per deliquium*, or even Salt Water, will presently make the *Acid* to let go the Silver, which will fall down or precipitate to the bottom in a White Powder (f).

The last and best way of Purifying Gold is by *Antimony*. Thus : Put the Gold in a Crucible, make it red-hot ; and when it begins to melt, pour upon it by degrees four times its weight of Antimony in Powder ; the Gold will presently melt ; continue a very strong Fire till you perceive the Metal to sparkle ; then take the Crucible out of the Fire and knock it, that the Gold may sink to the bottom ; break it when it is cold, and separate the fine Gold, which is called the *Regule*, from the drossy part.

After this melt the *Regule* again over a strong Fire in a Crucible, and when it begins to melt, throw into it by little and little, three times its weight of *Salt-peter* ; continue a very strong Fire to keep the Matter in constant fusion ; and when the Fumes are all gone, and the Metal appears *bright* and *clear*, cast it into an Iron-Mortar greased and warmed ; or else, if you do not value the Crucible, leave it in that to cool, and break the Crucible before 'tis quite cold, and then separate the *Regule*

(f) *Ibid.*

from its Dross remaining at the top, the Gold will be very pure (g).

Red Gold is less valuable, as containing most Copper; the Yellow is better, and it should remain Yellow while it is in the Fire.

Lazarus Erckern's way of purifying Gold that is separated by *Aqua-fortis* from Silver or Copper, is this: After the Gold-calx is dulcify'd and dry'd, mingle it with a little *Borax* and put it in a clean new Crucible, rubbed very well with Chalk, and set in the Fire; which must be gentle at first, and raised by degrees to a great heat, that the Gold may flow. When you would cast it, lay a little clean Paper upon it, which is luted with *Venetian-Soap* and *Wax*; and while the Paper yet burns upon the Gold, cast it out under the Flames (so it will retain no *Scum*, but cast it self clean) into an Iron-Vessel, that is warmed and luted with *Wax*. Quench the Gold with *Urine*, and so it will become neat and fine (h).

Pure Gold is commonly call'd *Gold of twenty-four Carats*. A *Carat* of Gold is properly the weight of twenty-four Grains or one Scruple; so that twenty-four *Carats* make an Ounce.

If an Ounce of Gold be *so pure*, that in its purification, (with *Antimony* or otherwise) it loses nothing at all, 'tis then said to be *Gold of twenty-four Carats*; if it lose one *Carat*, 'tis

(g) *Ibid.* (h) *L. Erckern, b. 2. c. 32.*

then *Gold* of twenty-three *Carats* ; and if it loses two *Carats* in purification, 'tis call'd *Gold* of twenty-two *Carats*, &c. But perhaps there is no such thing as *Gold* of twenty-four *Carats* ; for it will retain some small portion of *Silver* or *Copper*, purifie it as long as you will (i).

A *Carat* of *Diamonds*, *Pearls*, or precious Stones, is the weight of four Grains only (k).

How to graduate *Gold*, and give it an higher or a paler Colour (as there is occasion) and how to make brittle *Gold* smooth and dest, see in *Laz. Erckern*, Book 2. Chap. 45, 46, 47, 48, 49. The same Author also shews, how *Gold* in Ingots or coined Pieces may be Assayed by *Touch-needles* and by *Aqua-fortis*, B. 2. c. 9, 10, 11, &c. And in regard that the burnt Antimony, with which *Gold* has been purified, retains somewhat of the *Gold*, see the way to separate them, B. 2. c. 51.

As to the purification of *Silver*, 'tis made in the *Coppel* thus. Heat the *Coppel* gently and by degrees, till it grows red-hot ; then cast into it four or five times as much *Lead* as you design to purifie *Silver* : The *Lead* will soon melt and fill the sides of the *Coppel* ; then put the *Silver* into the midst of the melted *Lead*, and it also will presently melt ; then lay *Wood* all about and over the *Coppel*, and blow the flame

(i) Dr. Harris Lexic. Technic. (k) Idem ibid.

so, that it may reverberate on the Matter, the Impurieties of which will by this means mix with the Lead, and the Silver will remain *pure* and *unmixed* in the middle of the Copple; and the Lead mixed with the drossy Parts of the Silver, will lie on the sides like a Scum; this Scum is to be taken off with a Spoon or other Instrument, and is what is called *Lytharge*; Which, according to the degree of Calcination it has endured, is of divers Colours, and sometimes is called *Lytharge of Gold*, and sometimes *Lytharge of Silver* (1).

When the Silver is thus purified cast it into Bars in an Iron-Vessel made for the purpose, that is greased with Suet and warmed.

Having had occasion to speak of *Menstruums* in this Chapter, I cannot but with the Learned and Ingenious Dr. *Harris* take notice of the different Nature of them; for there are many *Menstruums* effectually corrosive, that will not work at all on some Bodies; which yet other things, though of no such corrosive Nature to the Tongue or the Touch, will readily dissolve: Thus Quick-silver will dissolve Gold, though there be no sensible appearance of any corrosiveness in the Mercury, either to the Finger, or even to the Tongue; and yet neither *Aqua-fortis*, nor Oil of Vitriol, nor Spirit of Nitre, will touch this Metal, though they are some of the most corrosive *Menstruums* in Nature.

(1) *Idem ibid.*

Cold Water will dissolve the white of an Egg ; which the purest Spirit of Wine will not divide, but coagulate ; as will also the Acid Liquors, Spirit of Salt, and Oil of Vitriol. Thus also common Oil will dissolve Brim-stone, though it appear so soft and smooth upon the Tongue, and will not dissolve so much as an Egg-shell ; and yet that general dissolvent, *Aqua-fortis*, will not touch Brim-stone. Many more Instances of this Nature might be given ; by which it appears, that *Menstruums* do not operate by Virtue of any *manifest* Quality, such as Heat, Moisture, or even *Acidity* it self, but rather by some *Mechanical* and peculiar fitness that there is between the Shape, Bulk, Solidity, &c. of the Corpuscles both of it and the Body to be dissolved (*m*).

C H A P. VII.

Of Sterling Gold and Silver.

PERhaps it may not be improper to give a short Account from the best Authors, of the *State and Standard* of the *Mint*, from the Reign of *Edward III.* downwards. I begin with *Edward III.* because the Records of the *Mint* are not clear and entire to any farther Reign.

(*m*) *Ibidem.*

Now in this Prince's time a pound Troy-weight of Gold was divided into twenty four Carats, and every Carat into four Grains of Gold ; and a Pound weight of *Old-Sterling* or right Standard Gold of *England* (for *Sterling* and *Standard* are Words of the same Signification) consisted of twenty three Carats and three Grains and a half of fine Gold, and half a Grain of Allay ; which Allay might be Silver or Copper.

Again, a pound weight Troy of Silver, was then, as it has been ever since, divided into twelve Ounces, every Ounce into twenty penny-weight, and every penny-weight into twenty four Grains ; every Grain of Silver was called a *Subtile-Grain*, sixty of which were equal to one Grain of Gold ; and a Pound weight of *Old-Sterling*, or right *Standard Silver* of *England*, consisted then, as it does now, of eleven Ounces, and two-penny weight of fine Silver, and eighteen penny-weight Allay.

The *Standard* for Gold and Silver held generally at this pitch till the Reign of King *Henry VIII.* when the Gold had sometimes one, sometimes two, and sometimes four Carats Allay ; the Silver being debased first to two Ounces, then to six Ounces, and afterwards to eight Ounces Allay. In the third of *Edward* the VI. the *Standard* of Gold was at twenty two Carats fine, and two Carats Allay ; and Silver six Ounces fine, and six Ounces Allay. In his fourth Year Gold held up at the *Old-*

Old Standard of half a Grain Allay ; and in his fifth Year, the Standard of Silver was three Ounces fine, and nine Ounces Allay : In his sixth Year *Sovereigns*, *Angels* and *Half-Angels* of Gold were kept up to the old fineness ; and some Pieces of another form sunk to twenty two Carats fine, and two Carats Allay ; The Silver-Coins being fixed at eleven Ounces one penny-weight fine, and nineteen penny-weight Allay.

In the first of Queen *Mary*, Gold was coined at twenty three Carats three Grains and a half fine ; and Silver eleven Ounces fine, and one Ounce Allay : The remaining Part of her Reign, the Silver as well as Gold was brought up to the *Old Standard*.

Queen *Elizabeth* called in the course Money, coined in the Reigns of *Henry VIII.* and *Edward VI.* and restored the *Mint* to the *Old Standard*, excepting that she sometimes coin'd Gold at twenty two Carats fine and two Carats Allay.

In the Reigns of King *James I.* and King *Charles I.* Gold was sometimes coin'd at twenty three Carats, three Grains and a half fine, and sometimes let down to two Carats Allay ; Silver still continuing in the fineness of *Edward III.*

In the twelfth of King *Charles II.* *Rials* and *Angels* were held at the *Old Standard* of twenty three Carats, three Grains and a half fine, and half a Grain Allay. Silver-Monies continuing

tinuing in the same state of fineness as before: But afterwards the pieces, since called *Guineas*, were wrought twenty two Carats fine, and two Carats Allay; Silver-Monies standing in the old degree of fineness. And in this Condition the Mint has remained in the Reigns of King *James II.* King *William* and Queen *Anne*: And this Standard both of Gold and Silver agrees with most of the Foreign Mints in *Europe*.

And here we may observe, that in the Reign of King *Edward III.* a pound of Gold made but fifteen Pounds in *Tale*, whereas in the Reigns of King *Charles II.* *James II.* *William*, and Queen *Anne*, the same weight is coin'd into forty four Pounds ten Shillings by *Tale*. And thus in the Reign of *Edward III.* a Pound weight of *Old-Sterling* Silver was to make no more then twenty two Shillings and six Pence: Whereas in the late Reigns and at this time, a Pound of *Old-Standard* Silver is coined into sixty two Shillings by *Tale*: From whence it follows, that one of the *Old* Shillings weighed very near three times as much as the *Modern* (a.)

There being a great disproportion in the plenty of Gold and Silver in the World, one has always been valued much higher than the other; so that one Ounce of Gold has ex-

(a) Mr. *Lounds's* Essay for the Amendment of the Silver-Coins. Mr. *Collier's* Supplement. Sir *Henry Spelman's* Remains. Sir *Robert Cotton's* Posthumæ.

changed for several Ounces of Silver. At present our *Guinea* passing for *twenty-one Shillings and Six-pence* in Silver, Gold is now about *fifteen times and a half* more worth than Silver; there being about fifteen times and a half more Silver in *twenty-one Shillings and Six pence*, then there is Gold in a *Guinea* (b). The proportion of *Alloy* for Gold used in our Mints, is about a *twelfth* part, and the fineness of Standard Silver in *England* is *eleven* parts Silver, and one part Copper, *near*.

The great change in the value of Silver has been made by the plenty of it, poured into this part of the World, from the *West-Indies*, not discover'd till *Henry the VII's* Reign. One *Shilling* in the *28th* of *Edward I.* (i. e. in the Year 1301) containing in it 264 *Grains* of fine Silver, but in the *43d* of *Queen Elizabeth* only 86, as *Mr. Lock* informs us from *Mr. Lounds* (c).

The same *Mr. Lock* tells us, that according to the Standard of our Law, *five Shillings* or a *Crown* is to weigh an Ounce, wanting about *sixteen Grains* (d).

(b) *Mr. Lock's Essay on the Coin*, p. 162. (c) *Idem*, p. 79.
 (d) *Idem* *ibid*.

C H A P. VIII.

Of Mines in General, and the great Advantage of them to this Kingdom.

SIR *John Pettus* tells us (a), It may be confidently affirmed, that as to all *Metals* (except Gold, of which we have yet discover'd but a small quantity) and useful *Minerals*, no proportion of ground in *Europe* affords better of all sorts (and quantities enough both for our own uses, and to supply others with good advantage) than this Island of *Great-Britain*. And it is clearly demonstrable, that every Year, for many Years past, this Kingdom has by neglecting these things lost a *Million* of Money, which by care herein might have been saved; whereby we want, when others abound with our own *natural Store*.

An ingenious Writer observes (b), That the Principal constituent parts of *England's* Wealth, are *Wool, Corn*, and our *Mines*, and that 'tis by the well-ordering and wise disposition of these Branches of our Wealth, that we are to be Gainers in the Balance of Trade; that our Mines are the Product of the Earth, and undoubtedly capable of great Improvements;

(a) In his *Fodin. Regal.* p. 31 & 34. (b) In his Essay on the Balance of Trade. See the Familiar Discourse of the Mine-Adventure, p. 100 & 132.

that we ought to respect them as the Parents of our Trade, and as that which made us known to the first Merchants of the World, the *Phenicians*. We have *Tin, Lead, Copper, Calamy, Iron, Coal, Culm, Allum, Copperas*, with other sorts of Minerals; and what is in this manner dug out of the Earth, cannot be a less Article in the whole Rental of the Kingdom, then about *seven or eight hundred thousand Pounds per Annum*. And 'tis the undoubted Interest of this Kingdom, to export as little *Silver and Bullion*, and as much of our own Commodities as we can, in order thereby to gain the *Balance of Trade*; which is the great thing we always labour'd for in *England*, and the only thing that can make this Nation truly *Great and Powerful*, and not only the most *Delightful*, but one of the *Strongest and Wealthiest* Kingdoms in the whole *Christian World* (c).

Sir *Josiah Child* tells us (d), That our *Lead and Tin*, which are *Natives*, and by God's Blessing inseperably annexed to this Kingdom, carry on much of our Trade to *Turkey, Italy, Spain and Portugal*; besides great quantities, that are sold to *Holland, France*, and to the *Indies*, as is well known to all Merchants that trade to those parts.

And Mr. *Carew* has these Words (e); 'The Womb of our Earth, being big with Trea-

(c) Mr. *Waller's* Essay on the Mines, p. 35. (d) In his Discourse on Trade. (e) In his Essay on the State of *England*, in Relation to its Trade, its Poor and Taxes.

‘ fure, longs to be delivered, and after many
 ‘ Throws, brings forth *Lead, Tin, Copper Ca-*
 ‘ *lamy, Coal, Culm, Iron, Allum, Copperas,* and
 ‘ fundry other Minerals; which return us great
 ‘ Treasure from foreign Markets, whither they
 ‘ are exported.

And Mr. *Waller* says (f), Our Mines bring
 in a clear *national* profit, and are an addition
 to the general and fundamental Stock of the
 Nation; that the Expences caused by them,
 as well as Gains, circulate in our own King-
 dom; that at the same time there are raised
 from them the Materials of a Staple Commo-
 dity, which imploy many *thousands* of Men,
 Women and Children, in the Manufacture
 thereof. That our *Copper* and *Tin* being ex-
 ported out of the Kingdom, will import their
 full value in Foreign Commodities, with-
 out carrying our own *Coin* and *Bullion* out of
 the Nation.

And if our Exports are of greater value
 than our *Imports*, then the *Balance of Trade* is
 gained (g).

Besides, as was just now observed, vast
 number of poor people do live by, and are
 employed in working of Mines, the very Wo-
 men and Children finding Employ therein, as
 well as the Men, especially in the Mines
 of *Lead*. At *Keswick* in *Cumberland* four
thousand Men were employed in the *Copper-*

(f) In his Essay p. 2. (g) The Familiar Discourse of the
 Mine-Adventurers, p. 132.

Mine in the Reign of *Queen Elizabeth*. At a *Mine* in *Arkendale* in *Yorkshire* six hundred Men were lately employed. In the *Mines* of *Alston-Moor* in *Cumberland* a thousand persons were employed. At *Consumblock*, a *Silver-Mine* in *Cardiganshire*, four hundred Men were employed by the *Patentees* of *Royal Mines*, for many Years. In some of the *Tin-Mines* in *Cornwal* above fifteen hundred Men are employed (b).

In other Countries, as in *Germany*, *Sweden*, *Poland*, &c. they employ greater numbers. The *Mine* of *Potosi* in *Peru* has lasted above a hundred and fifty Years, with many thousand Men at work in it (i). In the *Silver-Mine* called, *Of the Trinity* in *New-Spain* nine hundred or a thousand Men are at work (k). *Windschalt-Mine* in *Hungary* employs two thousand Men (l).

As to the Profit and Advantage that Mines bring to their particular Owners, it is sometimes very great; whereof many instances are given by *Mr. Waller* in his *Essay*, p. 13.

Mr. Shiers, Secretary to the *Governour* and *Company of Mine Adventurers*, has informed the World (m), that they have already made above *Cent. per Cent.* of the Money expended upon their Mines, notwithstanding all the disadvantages and dead charges in the beginning of that Undertaking.

(b) *Mr. Wallers Essay*, p. 20. (i) *Idem*, p. 21. (k) *Dr. Gammelli's Voyage about the World*, p. 533. (l) *Dr. Brown's Travels*, p. 90. (m) In his *Mine-Adventurers Proposal*, p. 2.

C H A P. IX.

Shews, why our Mines have been so much neglected, notwithstanding their Profitableness.

ONE great Cause why Mines have been so much neglected, was the *Terror* of a *Royal Mine*. People would not labour and be at great Expences in the discovery of Mines, for fear they should afterwards be taken from them. And if the Mines did prove *Royal*, then, for the most part, they were carelessly followed, as too much Experience has often verified.

A *second* Reason to be assigned for not seeking after Mines is, ' the great plenty of every thing necessary for Life : So that Hunger, which is the Prompter of covetous Desires, being wanting, there are but few that care to run a hazard (a). The End that Men commonly aim at in digging for Metals and Minerals, is *Gain* and *Profit* ; and the impulsive Cause that moves them to that End, is generally Poverty, Want and Necessity. But the greatest part, if not all, of the Subjects

(a) *Alonso de Ovalle's Historical Relation of the Kingdom of Chili*, p. 14.

of the Subjects of the Crown of *England*, being able to get a comfortable and sufficient Livelyhood, by other ways, as by *Pasturage*, *Tillage*, *Arts*, *Trades* or *Manufactures*, they have no such necessity put upon them, as to seek for a Maintenance, by such drudgery and slavish Labours, as Men must undergo, that work in those dangerous, dark, and sometimes unwholesome Mines: In some of which, as *Acofta* tell us (b), they must labour in continual Darkness and Obscurity, without Knowledge of Day or Night, in continual fear of being crushed to Death, and in so gross and poisonous an Air, that they are often choak'd with Damps, and always sick at their first going into the Mines, as those are who go to Sea. Some of the Workmen at *Potosi* see not the Sun for a long time together; many of them fall down from their high Ladders, made of raw Hides, with their loads of Silver on their Backs, pulling others after them, and many die in the Works for want of Air. With Wedges and Hammers they break the Flints and Rocks, how hard and strong soever; *For the Hunger of Gold is yet more sharp and strong* (c). So that it is plain, that in Her Majesties Dominions, few will undergo such servitude without Force, that can live better other ways.

(b) In his Natural and Moral History of the *West-Indies*, p. 232, and Dr. *Heylins* Cosmography, lib. 4. p. 130. (c) *Pliny's* Natural History, b. 33. c. 6.

A *third* Reason is, The small encouragement that Undertakers or Workmen have in our Nation, to undergo such Pains and Hazards, as necessarily they must, that meddle with such Matters: The Conditions of working, and their Wages, are for the most part so hard, as causes the Works often to be deserted and forsaken. And it is usual with the Workmen, if they can hear of another place where they may find better Wages, to leave both the Work and their Masters: And often it happens, that either divers Lords and Proprietors are at variance about the same Mine, or that divers pretend several *Grants*; so that while they are trying their Titles, the Work is neglected, and the Workmen betake themselves to some other Work: Or that where a Mine is discovered, that may lessen the Price of the Metal or Mineral that another gets, the Workmen of the one are hired away by the other, or some other such sinister Means used between them, as often proves the overthrow of the one or the other, if not of both; of which too many sad Instances might be given (*d*).

A *fourth* Reason hereof, is the common Disease or Humour of the *English* Nation, that are accustomed too much to doat upon *Foreign* Commodities, and *imported* Wares, which makes them negligent of looking into or improving their own *Native* Commodities,

(*d*) *Metallographia*, p. 21.

and such things as their *own* Country yields ; which has stirred up the Industry of our Neighbours, especially the *Dutch*, who can make greater Benefit of *our own home-bred Commodities*, then we our selves ; and therefore have for many Years past bought up and transported great Quantities of Lead-Ore, and refined it to their great Advantage (e).

A *fifth* Reason hereof, is, the dearness of Workmen in this Nation. (This does not contradict the *third* ; for though Workmens Wages be very low *here*, yet they are higher and greater than in those Foreign Countries, where the Mines are wrought by *Slaves* and *Criminals*.)

The Silver-Mine of *Potosi* in *Peru* in *America*, is work'd only by Slaves, to the Number of some thousands, which are brought from *Africa* ; where, as soon as the Ships arrive, great numbers of them are brought before the Factors in a large Plain, where by the Surgeons they are thoroughly examined even to the smallest Member, and such as are found and approved of are bought of their Owners, and sent on board to the number of six or seven Hundred in a Ship (f). The Masters of these Ships sell them to the *Spaniards* and *Americans*, who bring and put them into a great Inclosure near the Mine, where the Governour makes a distribution of them to the Condu-

(e) *ibid.* p. 22. (f) *Bosmans Description of the Slave-Coast of Guinea in Africa*, p. 365.

ctors of the Mine, according to the Numbers they want; and after six Days constant work, the Conductor brings them back to the same place, where the Governour causes a review to be made of them, to see how many of them are dead, that a supply may be made of the number that is wanting; for there is no Week passes but some of them die, either by divers Accidents that occur, as the tumbling down of great Quantities of Earth and falling of Stones, or by sulphurous Vapours, which dry them up, and hinder respiration, or by Sickness and other Casualties (g). And therefore, to supply themselves with more *Slaves*, the *Spaniards* send their *Barks* frequently to *Paita*, whither the *English* (who get well by them) send these *Negro-Slaves* from *Jamaica*, by the way of *Puerto Bello* (h).

The *Genoeses* have also a House at *Panama* for their Trade of *Negroes*, where they sell great Numbers of them to the Mines (i).

At the Mines near the Town of *Veragua*, some of the Inhabitants constantly attend, but none seek for Gold but the *Slaves*: These they compel to dig the Earth and wash it in the neighbouring Rivers, where often they find pieces of Gold as big as Pease (k).

The *Spaniards* had discovered in the Year 1617 two Gold-Mines, and a third of Silver,

(g) Monsieur *Acarete's* Voyage to *Peru*, p. 50. (h) The *Eucaniers* Voyage into the South-Sea; p. 139. (i) History of the *Eucaniers*, p. 149. (k) *ibid.* p. 74.

near the Town of *St. Thome* in *Guiana* which yet remained useless for want of *Negroes* to work them : For as the *Indians* cannot be constrained to it, having been exempted from such servitude by a Law of the Emperor *Charles V.* so the *Spaniards* will not nor can endure the Labour of the Mines (l).

But 'tis supposed, they are now better provided with *Negroes* ; for the *English, Dutch, French, Portugueze* and *Brandenburgers*, do yearly purchase great numbers of *Blacks*, or *Negro-Slaves* from *Guinea* ; where at *Fida* they are so diligent in the Slave-Trade, that they are able to deliver a *Thousand* Slaves every Month, which are sold again to the *Americans*, to be employed in their Mines and Plantations (m). These *Fidasians* send our *European* Commodities into the In-land Countries, (sometimes two hundred Miles deep) in order to exchange them for Slaves at the Markets ; for Markets of Men are here kept in the same manner, as those of Beasts with us (n). And to shew you how cheap this sort of Humane Flesh is in *Guinea*, some Miles Inland beyond *Ardra*, from whence most of the Slaves are brought, you may have one, nay, sometimes two Slaves, sold you for a handful of Salt ; which is there made in great plenty (o).

(l) The Life of Sir Walter Rawleigh, p. 210. (m) Besman's Description of Guinea, p. 343. (n) Idem, p. 363. (o) Idem. p. 308.

At *Coto* in the same Country, they drive a most advantageous Trade, by marching into the In-land Parts, and *stealing Negroes*, (and indeed most of the Slaves that are offered to sale are Prisoners of War, which are sold by the Victors as their Booty :) In which their Incurfions do commonly fucceed fo well, that in three Days time they return with two hundred Slaves; for the *Negroes* on the *Slave-Coaft* are very *Prolifick*, herein differing from thofe on the *Gold-Coaft*, that whereas the latter content themfelves with one, two, three, and moft confiderable of them, with eight, ten or twenty Wives, the former have forty or fifty, and their chief Men three or four Hundred: And *Bofman* faw there feveral of the *Blacks* who were Fathers of above 200 Children (*p*).

If it is thought very harfh and unnatural, that one part of Mankind fhould be thus inflav'd and hardly ufed by another, a *Necelfity* is pleaded for it: And where *Interest* is in the cafe, *that* will pafs for a ftrong Argument with the greateft part of Mankind.

The other *cheap* way of working Mines is by *Condemned Criminals*. The Mines in *Hungary* are thus wrought, or elfe they could not get a Farthing by them; whereas they bring in a vaft Revenue. And if the fame Law were in *England*, and an A& were paffed to fave the Lives of fome Criminals, condemned to dye for leffer Offences, and fend them to the

(*p*) *Idem*, p. 344 & 347.

Mines, to be there constantly employed in the most laborious Works, the Nation would reap the benefit of their Labour, and the Criminals would probably be brought to Repentance; for hard Labour will in time bring down the highest Spirits; and with God's Blessing and good management in a *Christian* Country, may bring them to a Sense of Religion and Vertue: And therefore for all Felonies and Larcenies, without Benefit of Clergy, 'tis thought such a Law would be of great Advantage to the *Publick*; and by it the Souls of many Men, might by the Grace of God, be eternally saved, as well as their Bodies, from utter Ruin and Destruction (g).

The *sixth* and last Reason I shall mention of the Non-proficiency of Metallick-Works, Mines and Minerals is this, that, generally speaking, there is no working of Mines to good advantage without a *large Stock*. And its generally observed that two or three Setts of Adventurers are either ruin'd or totally discouraged, before the Mines can be set in Order, and bring in profit; as it happened in the case of the great Mines at *Est-kyr-kyr*: There were two Setts of Undertakers disappointed before the *Company of Mine-Adventurers* was established, notwithstanding that the Ore appeared at the Day near the Surface of the Ground; and two or three small Stocks, to the value of six or seven thousand Pounds, were raised and spent, in

(g) The Familiar Discourse of the Mine Adventure, p. 146, &c.

carryihg up the Levels, erecting Smelting-Houses, and in other dead Charges, without the least return of clear Profit: which has so opened the Eyes of the private Proprietors of Mines, that very few will venture on them *now*, without a good back to support them (r). Upon this consideration, some Merchants and others, have lately obtained several Patents from the Crown, to incorporate themselves into Societies and Companies, for the working of Mines by Joint-Stocks: The beginning of one of those Patents is in these Words.

William and Mary, by the Grace of God, King and Queen of England, Scotland, France and Ireland, Defenders of the Faith, &c. Whereas we have been informed by the humble Petition of W. C. &c. That our Kingdom of England and Dominion of Wales, do much abound in Mines, especially of Lead, great part whereof remain unwrought, to the manifest loss of the Publick; and that the reason why, so great a part of the Wealth of our Dominions lie useless, is partly because there is not sufficient Diligence and Application used in discovering of Mines, and partly because the working of Mines being very chargeable, and the Profit subject to great hazard, many Owners of Land, where the Mines are, cannot, or dare not, themselves undertake the same. And whereas they have most humbly besought us, to enable them and divers others,

(r) itid. p. 98.

therein mentioned, in a Corporate Capacity, to dig and work such Mines as they shall be legally intituled unto, and to buy and refine Ore by a Joint-stock. Now, know ye, that we being desirous to promote all Endeavours tending to the Publick Good of this Kingdom, and to encourage so commendable an Undertaking, of our own especial Grace, certain Knowledge and meer Motion, have given, granted, constituted, declared and appointed, and by these Presents, for us, our Heirs and Successors, do give, grant, constitute, declare and appoint, That our Right Trusty and Well-beloved J. Lord C. &c. and such others as shall be admitted into the said Society, henceforth be, and shall be, one Body Corporate and Politick, in Deed and in Name, by the Name of, The Governour and Company for digging and working of Mines, and for buying and refining Ore by a Joint-stock in England, &c. (s).

Which Patent is dated Sept. 7. in the fifth Year of their Majesties Reign.

By Writ of Privy Seal.

Piggot.

Pro fine in banaperio Viginti Marcas.

J. Somers, C. S.

C H A P. X.

Some Objections against Searching for and Working of Mines answer'd.

THE First and Chief Objection is grounded on the vulgar Opinion, that England lying so far from the *Æquator* in Northern Latitude, cannot be thought to yield any great store of *Metals*; it being commonly suppos'd, that the Southern *Climates* are most fertile of them, by reason of their nearness to the *Sun*.

Now though a short answer might be made to this, from the richness and number of those Mines already discover'd, and the great plenty of good Ore, with which this Nation has abounded for Ages long ago (a); yet since this *Conceit* has taken deep root in many Persons, to the great hindrance of the Mining-Trade, I shall endeavour to shew, that the Sun has but very little influence in the Generation of Metals, and that there is no reason to think the Planets were condemned to labour in the Mines.

For, *First*, The Mines lie sometimes so very deep in the Bowels of the Earth, that it can hardly be imagined how the Sun should have any effect upon them. The Miners are forced in

(a) Camden's *Brittania*, p. 148.

many places to dig *forty, fifty, or sixty* Fathom deep, before they come to the Metal. The Silver-Mine at *Potosi* is wrought above a *thousand* Yards deep, as *Acosta* assures us : And Dr. *Brown*, in his Travels to the Mine-Towns in *Hungary*, informs us, that at the Mine at *Chremnitz*, he went down by the *Pit*, call'd by the name of the Emperor *Rodolphus's Shaft* (gently descending by the turning about of a large Wheel, to which the Rope is fasten'd) a *hundred and eighty Fathoms* deep into the Earth, and after many Hours being in the Mine, was drawn out again by *Leopold's Shaft*, streight up, above a *hundred and fifty Fathoms* ; a height surpassing that of the *Pyramids* by a third part.

Secondly, The Mines do not only lie sometimes very deep, but are also inclosed on every side with great *Rocks* of a wonderful *hardness* and *thickness*. Which consideration, though it will not make me to be of Dr. *Leigh's* (b) and *Le Clerc's* Opinion (c), That *Metals* are not *germinated in the Earth*, but *have been there before, or since the Flood* ; yet, I think, it renders it hardly credible, that the Sun has any great force or influence in the production of them.

Thirdly, It is a common Observation, that the Ore grows *richer* and *better* the deeper they dig, and that the nearer the Surface, the worse

(b) In his Natural History of Lancashire, p. 89. (c) Forte etiam, quicquid est Auri & aliorum Metallorum, ab initio rerum, una cum terra genitum est, neque amplius ullum gignitur, Physic. l. 2. c. 4.

it is; and poorer; which sure should be otherwise, if its nearness to the Sun, and being exposed to its Heat, signified any thing.

Fourthly, It is very well known, that the South-side of a Mountain, that is continually exposed to the Sun's scorching Beams, is no richer in Metal than the North-side, and sometimes not so rich; the great Silver Veins in the Mine of *Potosi* running upon the *Northern side* of the Mountain (*d*).

Fifthly, Those Countries, in which the richest Mines are discovered, are not so hot, as most people imagine, and are apt to believe. *Garcilasso* tells us (*e*), That *Chili*, a great Country in (Southern) *America*, is very cold, occasion'd by the high Mountains *Los-Andes* and *Sierra-Nevada*, which lying Eastward, deprive it of the Morning Sun. To this agrees *Dr. Heylin*, who informs us (*f*), That this Country had its Name from the word *Chil* (which in more Tongues than ours does signifie as much as *Cold*) by reason of the extreme coldness of the Air and Clime, so vehement here even in our Summer Solstice, that many times both the Horses and Riders are frozen to death. And therefore 'tis no wonder, that another *Geographer* tells us (*g*), That in the Winter the cold is here so excessively piercing, that both Man and Beast do perish in great numbers; and yet *Acosta* af-

(*d*) *Barba's Art of Metals*, p. 103. (*e*) See *Morey's Dictionary* in the Articles. *Chili* and *Pern*. (*f*) *Cosmography*, p. 130.
(*g*) *Gordon's Geography*, p. 394.

firmis (b) that there is abundance of Gold in *Chili*, and that the most famous and purest Gold is brought from *Baldivia* in that Country; where the Mines were in his time of such infinite Riches, that the Governour of them thence daily received by the labour of each single Workman, to the value of 25000 Crowns, and sometimes more.

De Laet in his History *de Novo Mundo*, informs us, that the Kingdom of *Peru* (in which are those never-decaying Mines of Gold and Silver) in the same *America*, though it lies between the *Line* and the *Tropick* of *Capricorn* in the *Torrid-Zone*, and formerly was thought not habitable by reason of heat, is known to be of great Temperature; nay, that a third part of it is extreme cold, and subject to perpetual Rains and much Snow. Other Authors tell us (i), that even about *Potosi* where they dig and refine thirty eight Millions five Hundred thousand Pound weight of Silver yearly (k); and from whence the King of *Spain* in less then forty Years, for his fifth part receiyed above a hundred and eleven Millions of *Pezos*, every *Pezos* being valued at 6 s. 6 d. and yet a third part of the whole was discharged of that Payment (l). I say, we are told, that about *Potosi*, which is in *Peru*, the Air is so cold, that it makes the Fields almost barren, which bear

(b) In his Natural and Moral History of the West Indies, p. 214.

(i) Du Perron and Thevenot in their Voyages. (k) Mr. Waller's Essay, p. 10. (l) Dr. Heylin's Cosmography, p. 1652.

nothing but Oats, which scarce ever ripen, but are cut up and given to Horses in the Blade: And *Acosta* affirms of the Mountain (in which are the Mines) of *Potosi*, that the Ground and Soil of it, is very cold and unpleasant, and is naturally not habitable for the sharpness and intemperature of the Air (*m*). And yet when *Pizarro* the Spaniard, discovered this Country in the Year 1525. Gold was so plentiful in it, that their Vessels for common use, and their Utensils were made of it; and they had Chairs and Litters made of massy Gold; and some of their Temples and Houses were covered with Plates of Gold and Silver (*n*).

And we are assured by Dr. *Heylin* (*o*), That a place called *Castro Varena* in this Kingdom of *Pern*, is enriched with Mines of the purest Silver, digged out of a dry and barren Hill, always cover'd with Snow, and standing in so sharp an Air, that the Spanish Women cannot bear to be deliver'd in it, but are carried farther off, to be brought to Bed in a more temperate Climate.

Some parts of the foresaid Kingdom of *Chili* are so very cold in Winter, that the Birds are driven out of them by the rigour of the Season (*p*).

(*m*) History of the West-Indies, p. 219. (*n*) Du Perron and Thevenot's Voyages. (*o*) Cosmography, b. 4. p. 128. (*p*) Alonso de Ovalla's Description of the Kingdom of Chili. p. 26.

In the Province of *Veragua* on the North-side of *America*, where the Air is very cold, Seignior *Pezoro* the Governour of it, kept in the Year 1573. a hundred Slaves at work in the Mines, each of them being bound to bring in daily so many *Pezo's* of Gold, as amounted to above 200 *l.* Sterling (q).

In *Monomotapa* in *Africa* are many Gold-Mines, and very rich ones at *Matuca* in the same Country, notwithstanding that it is a very cold place, where the Inhabitants have in the Winter such deep Snows, that they are often frozen to death. Also *Torra* or *Butua* in that Country, is enriched with inexhaustible Mines of Gold; and yet the Air here is very cold, by reason of the sharp Blasts coming from the *Antartick Pole* (r).

In *China* in *Asia*, though it be situated between the 20th and the 41st Degrees of Latitude, it is *excessive cold*, as Dr. *Gamelli* assures us (s); and yet here is found in the Rivers great plenty of Gold, that is very cheap and very rich.

Now where the Air is so very cold, we cannot suppose Mines to be much impregnated by the heat of the Sun. But further,

Sixthly, Very rich and good Mines are found in those Countries, that are more remote from the Sun than we are.

(q) Sir *Francis Drake's Voyages*, p. 44. (r) Dr. *Heylin's Cosmography*, p. 63. (s) In his Description of *China* in the Collection of *Voyages*, p. 321 & 378.

In Sweden, one of the Northern Kingdoms of Europe, there are Mines of Silver, Copper, Iron, and Lead. And in Norway, which is more remote from the Sun, lying North of Sweden, and parted from it by a Ridge of Mountains always covered with Snow, and very cold, a Mine of Gold was discovered in the Year 1646, (t). And the publick Prints of March 23. 1699. informed us, that a Gold-Mine was discovered in Norway, by some Gentlemen, as they were a hunting, which was so rich, that sixteen pound of Ore yielded seven pound of pure Gold; that the King of Denmark held a Council of his Ministers of State about it, and all the chief Officers that were skilled in Mines assisted at the same with their Advices. In the same Country were discover'd, some Years ago, divers Silver-Mines, particularly two, whereof one was termed *Benedictio divina*, and the other *Bonæ Spei*, though both of them were quickly exhausted. However, in the former of these, Anno 1630, was found a Mass of Silver, valued at three thousand three hundred and seventy two Imperial Dollars. And from the other was taken out a Mass of Silver, valued at five thousand such Dollars. Both which Masses, and some others of pure Silver from these Norwegian Mines, are now to be seen in the *Museum Regium* at Copenhagen, the King of Denmark's Capital City (u). And Wormi-

(t) Wormius's Museum, p. 116. (u) Gordons Geography, p. 76.

us saith (w), That *Christian IV.* King of *Denmark*, had a Mass of Silver of *five Talents* weight, digged out of the Mines at *Norway*, where some of the Ore did yield *ninety pound* of Silver in an *hundred* weight.

On *Cramford-Moor*, among the Waists in *Scotland*, after Rains, the people find pieces of Gold, some of which are of a considerable bigness (x). Mr. *Boyle* had several of them presented to him, which he again presented to that curious Examiner of Ores, Prince *Rupert* (y).

An *Englishman* found some Gold-dust in a Mountain near the River *Locky* in *Scotland*: And that there have been Gold-Mines in that Kingdom is clear from the Manuscripts mentioned by Dr *Nicholson*, now Bishop of *Carlisle*, in his late *Scots Historical Library* (z).

There are Mines of Silver, Tin, and Lead, in the Isles of *Orkney* and *Schetland*, which are near to and belong to *Scotland* (a). And King *James I.* received a thousand Pound in Silver-Ore out of a *Scotish* Mine (b).

Nay, even in the Islands scituate in the *Frozen-Ocean* have been found great plenty both of the best Metals and Minerals: For *Cristian V.* King of *Denmark* in the Year 1605, sent three Ships under the Commarl of a *Danish* Gentle-

(w) In his *Musæum*, p. 116. (x) *Cambden's Britannia*, the new Translation, p. 915, & 923 (y) Mr. *Boyle's* Hydrostatical way of examining Ores, p. 182. (z) *Martins* Description of the Western Islands of *Scotland*, p. 339. (a) *Idem* *ibid.* (b) History of the first 14 Years of King *James I.* p. 13.

men and an *English* Captain to *Greenland* ; out of the Mines of which they carried back a great many Stores to *Denmark*, where out of every *hundred* weight of them they extracted *twenty six* Ounces of Silver. There was also brought from thence much Gold-Ore and Sand intermixt with Gold ; and yet in this Country from the 14th of *October* to the 3d of *February*, they never see the Sun, nor does he all that time ever so much as peep above the Horizon (c).

An *Island*, which lies opposite to *Green-land* in the *Frozen-Ocean*, though no *Metals* have been hitherto found in it, affords abundance of *Brimstone*, which is a *Mineral*, and is usually found among *Metals*, and supposed to be an *Ingredient* in their *Composition* ; and yet in this Country about the *Winter-Solstice*, whilst the Sun is in *Sagitary* and *Capricorn*, the whole Body of the Sun does for two Months successively not rise above the *Horizon* : And in the shortest Days not above *half* of it, from ten of the Clock in the Morning till two in the Afternoon, the ordinary time of Sun-set here at that Season (d). Nay, a modern *Geographer* assures us, that in the *Northern* parts of this Country ; which for the most part are covered with Snow, they want the Sun entirely for one Month in the Year (e).

(c) Collection of Voyages, printed in the Year 1703, Vol. 2, p. 459, 462, 464, 468. (d) Ibidem p. 433. (e) Gordon's Geography. p. 336.

So that besides what *Philo* writes (f), that Gold, Silver, and other Metals, grow usually in Land that is barren and unfruitful, I know no other Reason, why there is so great abundance of Metals at the *West-Indies*, more then any other place, but the sole Will and Pleasure of Almighty God, who has imparted his Gifts, as it pleased him.

A *Second* Objection is, the *Failing* of Mines, and that Mines under Ground are *uncertain* Things; and if they should happen to *fail* or be quickly exhausted, then all the Money laid out upon them will be lost.

In answer to this, take Mr. *Waller's* Opinion, a Person of great Understanding in Mines, who says (g), That Nature is regular in its Productions under Ground, as well as above; and that when Miners have once found the *Main Vein* betwixt its firm sides, they seldom or never lose such a Vein, without an apparent Reason above Ground, (as by some very deep Dingle or Valley,) especially in Lead or Copper-Mines, where the Veins lie usually *perpendicular*, or sloping downwards; but for *Horizontal* Veins, as in Coal sometimes, a perpendicular Rock will cut its Veins in two; and thereupon the Vein may rise or fall on the other side, which ingenious Artists rarely fail

(f) *de Genes. Mundi. lib. 5.* (g) In his Essay on the Mines late of Sir Carbery Price, p. 32 & 33.

to recover again : And the bottom of any fixed Veins, especially of large settled ones, with firm sides, was never found ; but the Works have been left off, when they had been carried as deep as the Water would permit.

Another Author tells us (*b*), That settled Veins, which bear Ore near the Surface of the Ground, did never fail or miscarry, at the bottom of the deepest *Levell* that ever was made ; but on the contrary, they were always observed, to grow richer and better, as they were work'd lower and deeper. An Instance whereof we have in the Mine of *Potosi*, which has lasted from the Year 1546 with many thousand Men at work : It is, (as was said before) a thousand Yards deep ; and being very crooked and far under Ground, the Men carry the Ore on their backs, each Man about *fifty* Pound weight, in Wallets, on Ladders made of *Neats* Hides, three and three in a row ; one of the three having a Candle tied to his right Thumb, to give light to the rest (*i*).

The Mine of *Consumblock* in *Cardiganshire* in *Wales* was wrought by the ancient *Romans* and *Saxons*, and afterwards by the *Patentees* of *Royal-Mines* in several Reigns ; and yet the *Mine-Adventurers* have discovered the same in fresh Ground, and the Vein is larger then e-

(*b*) The Familiar Discourse of the Mine-Adventure, p. 71.

(*i*) Mr. Wallers Essay, p. 11. See also *Acosta's* Natural History of the *West-Indies*, and the History of the New-World, by N. N.

ver, and yields above sixty Ounces of Silver in a Tun of Lead (*k*).

The *Silver-Mine* upon the *Pyrrenian Hills*, which for a long time yielded every day *three hundred* pound weight of Silver (or as *Dr. Heylin* will have it, three thousand pound by *Tale*) was wrought *three hundred* Years, being at last a mile and a half deep (*l*).

The rich Mines of Gold and Silver in *Gallicia* in *Spain*, and the *Astures*, and some part of *Lucitania*, for many long Years afforded yearly unto the *Romans*, 20000 pound weight of Gold, amounting in our Money to two Millions of Crowns (*m*).

At *Pachuca* in *New-Spain* there be two rich Mines; the first called *Santa-Cruz*, which is of the depth of 224 *English* Yards; the other called *Navarro*, which is 195 Yards deep; and both of them have been working for many Years (*n*).

The Mine, which is called *Of Trinity* in the same Country, is of the depth of above 250 *English* Yards, and yet is of so great Riches, that persons of Reputation and well acquainted with the place, assured *Dr. Gamelli*, when he was there so lately as in the Year 1698, that in *ten* Years before, there had been *forty* Millions of Silver drawn thence; nine

(*k*) The second Discourse of the Mine-Adventure, p. 50. (*l*) *Plin. Nat. Hist. l. 33. c. 6.* (*m*) *Dr. Heylin's Colmography*, p. 222. (*n*) *Dr. Gamelli's Voyage round the World*, p. 533.

hundred or a thousand Men working therein every day (o).

These Mines are *so* deep, because they always dig down *perpendicularly* to find the Veins of Silver, which being dug away, as they lie *horizontally*, they again begin to sink deeper, till they find others (p).

The best and finest Silver in all *America*, is that of the Mine of *Aranzasse* (near *Potosi* in *Peru*) where besides the prodigious quantities of Silver, that have been taken out of Veins among the Rocks, in which the Metal evidently appeared, and which are now exhausted, there are almost as great quantities of it found mixed with Earth, in places where they had not digged before (q).

The Mine at *Goslar* in *Germany*, formerly belonging to the Duke of *Saxony*, and afterwards to the Duke of *Brunswick*, has been in constant working for above *seven hundred Years* (r); and so have the Silver-Mines near *Cottenberg* in *Bohemia*, which are above *seventy or eighty Fathoms* deep (s). Also one of the Silver-Mines at *Frieberg* in *Misnia* has been wrought since the Year 1180, being *three hundred Fathoms* deep (t).

The Mine at *Chrennitz* in *Hungary* is *nine or ten English Miles* in length, and *a hundred and seventy Fathoms* deep, and has been

(o) *Idem*, p. 534. (p) *ibidem*. (q) *Monsieur Acarete's Voyage to Peru*, p. 49. (r) *Sir John Pettus's Essay on Metallick Words*, p. 88. (s) *Dr. Browns Travells*, p. 121. (t) *Idem*, p. 134.

wrought above *nine hundred and fifty Years*, a *Dr. Brown* informs us (u).

For all great Veins of Ore, *Mr. Waller* tells us (w), are in some respect like a great large spreading Oak, and have a great number of Branches, which like the Boughs of a Tree, shoot out from the Body of the Vein; inso-much, that when a considerable Sum of Money is gained out of the same, and many Years spent in the working thereof, so that one would be naturally apt to think, that the Vein was almost work'd out, there are still discovered *fresh* Veins, shooting forth from the sides thereof, which are innumerable, and scarce ever to be exhausted.

Though indeed it cannot be denied, that Miners have sometimes met with *Belly's* of Ore (especially where the Veins do lie betwixt Limestone-sills or sides, or where the Sills do often change,) or a *Heaped-Mine*, from which no Veins run, either downward or side-ways (x). *Mr. Waller* himself gives us an instance of such a one in the *Lead-Mines* of *Cumust-with*, where the Metal is found in a *Lump* together (y). And this agrees with the Observation of the learned *Dr. Woodward* (z) viz. That in the *Metallick* and *Mineral* Kingdom, there is nothing *so regular, constant and certain*, as *entirely* to be trusted to and relied upon.

(u) *ibid* (w) *Essay*, p. 47. (x) *Familiar Discourse*, p. 71. *Barba's Art of Metals*, p. 102. (y) *Description of the Mines*, p. 18. (z) In his *Natural History of the Earth*, Part IV.

A *third* Objection is made from the *hardness* of the *Rocks*, within which *Mines* are sometimes inclosed, which it is difficult and chargeable to get through (a).

But to this it is said (b), that it is a constant Observation among all *Miners*, that *the harder the Rock, the richer the Mine*; Nature generally making the *Case* stronger or weaker, according to the richness of the Treasure therein contained: For where-ever the sides of a Vein are crackt and broken, the Mineral-water that feeds the Vein, runs off, and the Vein proves dead, or very poor; but when the sides of a Vein are solid and firm, without Cracks, *the Mineral Feeder* impregnates and enriches the Mine, and the same proves quick and rich in Ore.

The Members of *the Company of the Mine-Adventurers*, had lately the good fortune in the famous Mine of *Consumblock* (which in the Reign of King *Charles I.* yielded 20*l.* or 80 Ounces of Silver in a Tun of Lead (c), as by the force of Gun-powder to get through that Rock which the old *Romans* left behind them, as never to be conquered, and are entered into the Vein between firm and solid sides (d).

The *fourth* and last Objection is made by a certain Gentleman; who says, 'It would not be proper or adviseable to encourage

(a) The Familiar Discourse of the Mine-Adventurer, p. 136.

(b) *ibid*, p. 137. (c) *Fodin. Regal*, p. 10. (d) The second Discourse of the Mine-Adventure, p. 30.

‘ Men to search for Gold or Silver Mines in
 ‘ *England* ; it being observable, that the Peo-
 ‘ ple of those Countries that are stored with
 ‘ them are very poor ; the digging and refi-
 ‘ ning of these Metals, taking up the Labour
 ‘ and wasting the Number of the Inhabitants :
 For which Reason the wise Policy of the *Chi-
 neses* will not suffer the *Mines* they have, to be
 wrought (e).

To this it may be answerd,

(1st) That 'tis not always true, that the people
 are poor, where the Mines are *rich* ; the King-
 dom of *China* it self, being one of the finest
 and richest Countries in the World, the Peo-
 ple enjoying the greatest Plenty of all Things
 and standing in need of nothing from abroad.
 And yet *here*, whatever that Gentleman has
 heard or read to the contrary, Dr. *Francis
 Gamelli Careri* (a very credible Author, who
 was there so lately as the Year 1696) informs
 us, that besides the Gold, which is brought
 in from the *Neighbouring* Countries, the *Chine-
 ses* make use of all the Gold they can find in
 their *own*, especially *that*, which is gathered
 out of their Rivers at the full Moon, from the
 Trenches made in the Channels. The Silver
 indeed (he says) is brought in by Strangers
 from *America* ; and for this reason the Em-
 peror of *China* calls the King of *Spain*, the

(e) A Letter sent to a Member of Parliament in the Year 1691,
 p. 15.

King of Silver : for there being no good Mine of it in his own Dominion, all they have there is brought in by the *Spaniards* in *Pieces of Eight*, and here reduced into Plates one quarter part finer (f) .

(2dly). We have in *England* (it is supposed) more people than there is Employment for, and the *Mining-Trade* would set on work many *thousands* of them, as was said before.

(3dly) The loss of so many Mens Lives, as every Year perish by Storms and Shipwrecks, is made no Argument against Merchandise, though many more are likely to be lost at Sea upon that account, then in the Mines, which promote Traffick, and are beneficial in many other respects.

(4thly) Though what that Gentleman says, may be true, That Gold and Silver drawn out of the Mine, do not equally enrich with *what* is got by *Trade*, yet *both together* may perhaps tend more to the publick Good than either of them *singly*.

(f) Description of *China*, in the 4th Vol. of *Voyages*, p. 378.

CHAP.

C H A P. XI.

Of the Manner and Way of discovering Mines.

MINES have been discovered several ways : As,

(1st) By *Chance*. So violent Currents of Water have wash'd off the first Coat of the Earth, and left the Veins of Metal naked to the Eye. Great Storms of Wind have many times tore up Trees by the Roots, and laid the Ore bare that was under them. The same effect has had the falling of Pieces of Cliffs and Rocks, caused by Thunder or great Rains : Oftentimes rich Veins of Metal have been discovered by the Plow ; so *Justin* tells us, *Gold* was found in *Spain*. *Diodorus Siculus* writes, that the burning of some Woods shewed some Silver Mines. *Agricola* tells us, that a Man, riding over the Country in *Gosolaria*, discovered a very rich Mine, by the Soil being broken with the small force of his Horse's Feet. The famous Mine of *Potosi* was discovered by a Man that was hunting, who running up that Hill, laid hold upon a small Tree, which coming up by the Roots, he took notice of some Particles of good Ore, that stuck to them, and searching further found it to be a *rich* Mine. The Mine of *St. Christophers* in the *Lypes* was
also

also found out by chance. A Man pursuing a Hare he had shot with a Gun, found her lying upon a rich *Farellon* of Silver which proved to be the third best Mine in all the *West-Indies*, viz. next to *Potosi* and *Oruro*. Such and much lesser Accidents than these, says *Barba* (a), have been *sufficient*, when Fortune has had a mind to distribute Riches to her Favourites.

Another way of discovering Mines is (as I may say) by *Industry*; when Men purposely search for them, where there seems to be a probability of finding them. Thus the *Negroes* in *Guinea*, apprehending where the Gold is, dig Pits and work them at a venture, without the least knowledge of any Veins of the Mine; and when they meet with any Gold, they separate it from the Earth, which comes out with it (b).

So in the *Moguls* Country, Men bargain for a piece of Ground, and then dig the Earth and sift it to find *Diamonds*; and according as they succeed in these Adventures, they grow rich or poor (c).

So it should seem, that formerly the Miners in the *Peak* of *Darbyshire*, did search for Ore at a venture; using this solemn *Expression* (d) when they began to dig, *By the Grace of God, and what I can find be. e.* An Instance also of

(a) In his *Art of Metals*, p. 92. (b) *Bosman's Description of Guinea*, p. 60. Dr. *Camilli's Voyage round the World*, p. 254.

(d) *Manlow's Customs of the Barge-Moot-Court*.

this Nature, *Barba* gives us, in the rich Mine of *Chocaia* ; which (for the encouragement of Miners) after they had followed some small Veins belonging to it for forty Years, with little success and very little profit, at length requited their Patience and Perseverance with *extravagant Riches* (e).

Dr. *Brown* tells us (f), that the Miners at one place in *Hungary*, had digged streight on *six* Years, when the Ore was but two Fathoms distant from the Place where they began : And in another place (he says) they digged *twelve* Years out-right ; and at last found a Vein, which in a short time very well paid their Charges (g).

The *third* way of discovering Mines is by observing the *Marks* and *Signs* of them ; the chiefest of which are these. The Plants that grow over the Veins of Metal, are not of so great a Growth, nor so strong a Colour, as others of the same kind ; the Exhalations which come from the Veins (when they lie near the Surface of the Earth) blasting them and hindering their Perfection ; the Water that comes from Springs is to be taken notice of. Barren Mountains are said to be a sign of Metals, the Vapours, that come from them, destroying the Plants and Grass : Sometimes the superficial Earth that covers them, is of a different Aspect from other Earth. But the inside of the Earth is chiefly to be regarded ; and 'tis a

(e) *Art of Metals*, p. 105. (f) in his *Travels*, p. 89. (g) *ibid.*

good sign to meet with *dry* Earth, if it be *yellow, red, black, green*, or any other extraordinary Colour. *Agricola* thinks it a good sign to meet with *Sand*, if it be exceeding fine, and very ill to meet with Earth full of little *Flints* if it hold long without changing into another Soil. The most rich Earth or Ore of *Potosi*, is of the Colour of Amber; and the next is that which inclines to black; there is other somewhat red, and other of the Colour of *Ashes*: Finally of divers and sundry colours, which seem to such as know them not, to be *Stones* of no value, but others of better skill do presently know their Quality and Perfection, by certain Signs and small Veins they find in them (*b*).

In short, the *Signs* that Writers give of *Metallick* Veins are infinite and endless; and yet none of them to be trusted to, so as *positively* to make any Judgment from thence, according to the assertion of Dr. *Woodward*, who says, that neither the *Colour*, nor *Figure* of Metals is to be relied upon in this case (*i*).

And therefore the *Honourable* and *Learned* Mr. *Boyle*, having observed such a great variety of *Appearances* and *Disguises* of Metalline Bodies, advises those that are given to the search of *Mines* and other *Fossils*, to be always ready, as they pass from one place to an-

(*b*) *Acosta's* History of the *West-Indies*, p. 232. and *Barba* of Metals, p. 106. (*i*) In his *Natural History* of the Earth, Part. 4.

other, to take notice of any unknown or uncommon *Fossil*, that they chance to see in their way ; there being in *England*, as well as in divers other Countries, *useful Fossils*, that are wont to be overlook'd by the unskilful (*k*).

The *fourth* way of discovering Mines, is by the *Virgula Divina*, or rather *Divinatoria*, the *Divinatory Rod* or *Wand*. This is spoken of by most Metallick Writers, and by some of them affirmed to be a sure Instrument to shew where the latent Veins of Metals do lie. All I can say of it is, (with *Mr. Boyle*) *They that have seen the Experiment of it, can much more reasonably believe it, than they that have not.*

Dr. Brown tells us, the *Hungarian Miners* make no use of it, having no opinion of it (as he observed they had at the Silver-Mines of *Freiberg* in *Misnia*, where he learned the use of it,) but dig always, as the Adventurers desire (*l*).

Agricola, after a long Discourse concerning it, gives us his Sense of it in these Words : *Metallicus igitur, quia, cum virum bonum & gravem esse volumus, virgula incantata non utetur ;* though in another place he says, the natural use of it may be allowed, in these Words: *Virgula in inveniendis venis usui esse potest, non enim valet virgulæ figura, nec incantamenta carminum* (*m*).

(*k*) Hydrostatick way of estimating Ores, *Señ. 11, p. 195.*

(*l*) Travels to Hungary, p. 89. (*m*) *de re Metallica. p. 26. 27.*

Paracelsus affirms, that the *Divinatory Rods* have deceived many Miners, that they are vain and frivolous, and that if they once shew any thing rightly, they on the contrary deceive ten times (n.)

The great *Kircherus* does reject them (o), and that upon his own trial, in these Words: *Certe ego sæpius hujus rei, supra metallica corpora, auri & argenti, experimentum sumens, semper spe mea frustratus sum.*

Mr. Boyle, having several times made trial, in the presence of the confidentest Assertors of the truth of it, could not satisfy himself, that the *Rod* did really bend, either towards the Metals, when placed under it, or towards the Metalline Veins, when he carried it over Mines, whence Metalline Ore was at that very time digging out (p).

Besides, there is so much Superstition used (by the direction of most Authors, who speak in commendation of it) in the getting of this Rod, so many exact Circumstances requisite to the Experiment, and so many different ways prescribed for the management of it, as gives a great Prejudice against it. Some observe a set Day and Hour, with certain Words and Ceremonies at the cutting it up from the Ground. 'It must be a *Hazel*, cut before the 'Sun rise, especially the Moon increasing, and 'above all, about the day of the *Annunciation*

(n) *de signaturis Rerum*, p. 12. (o) in his *Mundus Subterraneus*, p. 180. (p) *Physiological Essays*, p. 93.

' of the *Virgin Mary*, it must be almost a Yard
 ' long, of one Spring's growth, &c. Then you
 ' must tie it in the middle to your Staff with a
 ' Thread, and let it hang even like the Beam
 ' of a Balance; and carry it thus up and down
 ' (in a calm Morning) where you suppose there
 ' may be Mines; and when you come over
 ' where any be, the Rod will bow down its
 ' Root-end towards the Earth, as though it
 ' would grow there. When you see it do so,
 ' you must carry it round about the place, to
 ' see that it turns in the String still to the place
 ' on which side soever you stand; which if it
 ' does, then you have certainly found a Trea-
 ' sure (q).

As ridiculous as this Experiment seems to be,
 divers Persons, in other things very far from
 being credulous, have, as Eye-witnesses, with
 great Asseverations asserted the truth of it: Of
 which number is our diligent Countryman,
 Mr. *Gabriel Platt*, who (r) gives an account of
 the success he had this way, in these Words:
 ' About *Midsummer* in a calm Morning, I cut up
 ' a Rod of *Hazel* (without observing any set Day
 ' or Hour, or Words or Ceremonies at the cut-
 ' ting of it, which I have found to be little to
 ' the purpose;) this I carried up and down the
 ' Mountains where I thought Metals might grow,
 ' and before Noon it directed me to a Mine,
 ' which I presently digged to find; having ore

(q) Mr. *Wehster's* History of Metals, p. 108, 109. &c. (r) in
 his Discovery of Subterranean Treasure, p. 11 & 12.

‘with me with an *Iron-hook* and a *Spade*,’ and
 ‘within two Hours we found a Vein of Lead-
 Ore.’

Another is the Author of *Nova disquisitio de Helia Artista* (s), who affirms the truth of this experiment upon his own Knowledge, though he observed none of the before-mentioned Ceremonies.

Basilins Valentinus, in a large Discourse on this Subject (t), tells us, that though the using of the *Rod* is fallen into abuse among many People, yet however it is a fundamental way, to know and discover Mines, if duly and naturally used.

But if you should *thus* use it, and it happen not to move, when it is over the Veins of Metal, then they tell you, that it will not do so at *any* distance, (for the *Load-stone* will not act beyond the Sphere of its activity;) and therefore there may be great store of Metals in the Mountains, where the *Rod* is used; and yet they not lying near enough to the Superficies of the Earth, may frustrate its Effects; though if they had been within the Compass of its Virtue, it would have shewed them. And they say further, that it will but discover Mines at *some* times and *degrees* of their Concoction, when they send forth strong Steams, but not when they send forth little or none (u).

(s) In Mr. *Ashmoles Theatrum Chymicum*, Vol. 4. p. 271. (t) In his Last Will and Testament, chap. 23. (u) *Websters History of Metals*, p. 109 & 110.

And this I must take notice of, as peculiar to this Experiment, that the most knowing Patrons of it confess, that in *some* Mens Hands it will not at all succeed; some hidden Property in him that uses it, being able (as they say) to over-power and hinder its *inclinatory* Vertue (*w*). To which I must add, what a very famous *Chymist* solemnly protested to Mr. Boyle upon his own Knowledge, viz. that there are certain *unlucky* Hours, governed by particular *Planets* and *Constellations*, during which the Rod will not work, even in those Hands wherein at other times it manifestly will (*x*).

But if we will believe *some* Authors, several Mines have been discovered after a more easy way than any yet mentioned, and that is by *Dreams*; by which it's said Mines of great value have been found. Thus in the Reign of King *Edward VI.* a Gentlewoman (Heiress to one *Tresculiard*) in *Cornwall*, dreamed a Man told her, that in such a part of her Land she should find *Tin* enough to enrich her self and Posterity: Her Husband upon searching, found there a Mine of *Tin*, which in the first four Years was worth to him almost 4000 *l.*

Thus also one *Taprel* of *St. Niot* in the same Country, by a *Dream* of his Daughters, was wished to such a *Place*, which he farmed (having liberty to search for and work any

(*w*) Mr. Boyle's Physiological Essays, p. 94. (*x*) *ibid.*

Mine he should find in it) and found a *Tin Mine*, that made him a rich Man. *

I shall only observe, that one of the Head-workmen in the Mines of *Hungary*, told Dr. *Merin*, that where-ever it happens, that a rich Vein of *Gold* or *Silver* is stopped (as it often is) by certain hard Rocks (for whether the Vein be only interrupted or quite lost, they distinguish by certain Signs;) they make use of a certain *Mathematical* Instrument, which, one would think, should do them but little service in this case; and yet by the use of this, and the consulting certain Tables of *Inclinations*, they judge unto what side of the Mine the Vein runs, and consequently which way they must trace it. This is an Art (the *Doctor* saith) not to be despised by the *Curious*: He saw the Instrument, which is made of Brass, divided into certain Circles, with divers Needles touch'd by the *Magnet*, like those in the Sea-Compass (y).

The Manner of *dialling* Mines, and the way to bring up *Soughs* and *Addits* to hit any place or depth desired, and to know whether a *Sough* begun will lay a Mine dry, is too long to be here set down, and may be met with in several Metallick Writers, as *Houghton's Compleat Miner*, p. 68. &c.

* *Burton's Rarities of England*, p. 25. *Carew's Survey of Cornwall*, p. 180. (y) Dr. *Merin's* Journey to the Mines of *Hungary*, in the Collection of Voyages, Vol. 2: p. 824.

C H A P. XII.

Of the Position or Situation of Veins of Metal in the Earth.

AS to the Position of Veins of Metal in the Earth, either they run downwards *perpendicularly*, or (which is more usual) *sloping* from the *Horizon*, or *parallel* in the Ground, without any considerable depression from the *Horizon*. All these sorts of Veins are commonly found; although those are thought to be the *best* that run *downwards* (a).

Mines are sometimes found in the *Fissures* of Rocks and Intervals of the *Strata*. And in what *Vertical Plain* the Veins of Metals do generally run, has been curiously observed by all the Miners of *Europa*, as being thought certain Signs of the greater or lesser Riches; esteeming principally those Veins that run from *East* to *West*, or thereabouts, in the *Northern* part of the Mountain; and next to them, those that run *North* and *South*, or thereabouts, in the same part of the Mountain, which Point of the Compass, with a very little Declination Westward, the four principal Veins of the Mine of *Potosi* do observe; though at the same time, the rich Veins of the famous

(a) Barba's Art of Metals, p. 104.

Mine of *Oruro*, in the same Kingdom of *Peru*, run to *another* part of the Compass in *another* part of the Hills; and yet *this* Mine, for the abundance of good Metal, number of Workmen, and great depth, deservedly stands in competition with the Grandeur of *Potosi*. In short, very rich Veins of Metal run to several *other* Points of the Compass. So that after all, the best Rule to go by in this Case, is to follow the Metal, as it discovers it self, for there's no depending on any thing else. Besides, the Veins of Ore keep not *always* the same Point in the same Mine. So that the Miners have no certain way to know, either which way the Veins run, or where they are, till by industrious persevering in the labour of the Mines, they are at last found out; (b) unless they be skilled in the use of the Instrument mentioned in the last Chapter.

CH A P. XIII.

Of the Earth or Soil in which Mines are found.

IT is a vulgar Error and general Mistake, that Metals grow not in rich, and fruitful, and level, and low Grounds, but only in poor, Land, and

(b) Dr. Browns Travels, p. 89.

barren Hills and Mountains, as will plainly appear from the following Instances.

[1st.] Of Mines in rich and fertile Grounds.

The Land situate upon the River *Guipape* in *America*, contains several rich Mines, and yet the Soil in which they are found, is generally of the best kind for the Production of all sorts of Grain and Fruit, which it yields in extraordinary plenty (a).

On the North-side of the River of *Amazons* in *South-America*, in a Soil prodigiously fertile, the *Portuguese* discover'd a rich Silver-Mine in the Year 1697, and built a Fort by it, to secure it from the *French*, who laid claim to it, pretending it to be found in the *French King's* Territories (b).

The famous Silver-Mine of *Porco* in *Peru*, which had been anciently wrought by the *Inga's*, and was the first out of which the *Spaniards* dug any Silver, is situate in a very fruitful Soil (c).

The Country about *Acapulco* on the *South-Sea*, has more Gold-Mines in it than there be in *Peru*, tho' the Metal is not so fine; yet this Country is very good and pleasant, and full of people, and has several famous and very rich Towns in it, and the Soil in which the Mines are found, is fruitful in the production of all

(a) *Acugna's* Discovery of the River of *Amazons*, p. 170.

(b) *Voyages and Discoveries in South-America*, p. 2. (c) Dr. *Heylin's* *Colmograply*, in fine.

things necessary to the support and comfort of humane Life (*d*).

The *Free-booters*, in the Year 1687, attackt and took *Queaquilla* (which is the first Maritime Town on the South-Coast, as you go from *Panama*) and found in it to the value of five hundred thousand Pieces of Eight (*e*) in Gold and Silver coined, besides a prodigious deal of Plate; there being such a vast quantity of Silver in this Country, that most of those things, which they make in *England* and *France*, out of *Steel*, *Copper* and *Iron*, are here made of that rich Metal. All which Gold and Silver is brought to *Queaquilla*, from the *Mines* about eighty Leagues off, which are found in Grounds of so great fertility, that they produce to the Tillers of them, three Crops every Year, both of Corn and Wine (*f*).

About fourteen Miles from *Tinsgal*, in the Province of *Costa-Rica* in *New-Spain*, is a very considerable Gold-Mine, which in a few Weeks in the Year 1687, yielded above four hundred and fifty pound weight of Gold; and yet this Mine grows in a rich Soil, that bears all sorts of Grain and Fruit (*g*).

The rich Copper-mine, in which were Veins of Gold and Silver, which was found out in the Reign of Queen *Elizabeth*, at *Keswick* in

(*d*) Journal of a Voyage into the South-Sea by the Buccaneers of America, p. 147, & 153. (*e*) A Piece of Eight is about 5 s. Sterling, (*f*) The Free-booters Voyage into the South-Sea, p. 115, 124 and 137. (*g*) *ibid.* p. 112.

Cumberland, is situate in a fruitful Field (b).

Fountain in *Yorkshire* is delicately situated in a fruitful Soil, wherein Veins of Lead are found.

(i.) About *Gisborough* in the same County, the Soil is fruitful, and produces Grass and fine Flowers a great part of the Year, and yet richly abounds in Veins of Metal (k).

[2dly.] Of Mines in low Grounds and Valleys.

The Gold-Mines in the *Isthmus* of *Darien* are found in the woody and low parts of the Country, where the Rivers are so oozy, that the stinking Mud infects the Air, and makes it very unhealthy (l).

There are Mines of Gold in the low Grounds in the Kingdom of *Chili*, as you may see in *Alonso de Ovalle's Historical Description of it*, p. 14.

In the *Valley* of *Carauayan* at the Foot of the high Mountains in *Pern*, called the *Andes*, are rich Mines of fine Gold (m). But the most famous and purest Gold is brought from the Mines of *Baldivia* in the *Valley* of *Gandellenguen* (n).

In the *Valley* of *Joachim* near the Mountains of *Bohemia*, are very ancient and famous Silver Mines (o).

In the *Vales* of *Wents-dale* and *Spall-dale* near *Richmond* in *Yorkshire*, there is great store of Lead (p).

(b) *Cambdens Britannia* (new Translation) p. 822. (i) *Idem*, p. 716.

(k) *Idem* p. 753. (l) *Waser's Description of the Isthmus of Darien*, p. 53.

(m) *Dr. Heylins Cosmography*, p. 1056. (n) *Acosta's History of the West-Indies*, p. 214.

(o) *History of Metals*, p. 44. (p) *Cambdens Britannia*, p. 759. & 761.

[3dly.] Of Mines in the Champion or plain Grounds.

Newland in *Glocestershire* stands in a pleasant Plain, where are vast Mine-pits of sixty or seventy Foot deep, some of them as large as a considerable Church (q). And I have seen several good Lead-Mines in the level Ground and Champion of *Darbyshire*, viz. on *Brasington-Moor*, which is twelve Miles over; and am told by a worthy Gentleman of that Country, that there are Mines of good Lead in *Haddon-Field* in that County, which is certainly accounted one of the richest Pastures in *England*.

So that Mines are found in all sorts of Earth or Ground; or, as Dr. Woodward expresses it, in all sorts of *Terrestrial Matter*.

C H A P. XIV.

Of the Cause and Matter of Metals.

AS to the efficient Cause of the Generation of Metals, I shall not set down all that fanciful Men have invented upon this Head. It may be sufficient to say with Dr. *Jordan* (a), that God Almighty has placed a *Metalline Plastique Principle*, a *Seminary Spirit* of Metals, in

(q) *Idem*, p. 245. (a) In his *Treatise of Natural Baths*, c. 11. p. 53. &c.

the Bowels of the Earth ; which meeting with convenient and disposed Matter, turns it into this or that sort of Metal, according to the Nature of the Matter : Which Matter it works upon like a *Ferment*, which causes and produces an actual heat, that is still encreased by a further Fermentation of the Matter, as we see in the making of *Malt* ; where the Grains of Barley being moistened with Water, the generative Spirit in them is dilated and put into Action ; but the superfluity of Water being removed, which might choak it, and the Barley laid in Heaps, the Seeds gather heat, which is increased by the contiguity of the Grains, that lie in great numbers one upon another : In this Work Nature's intent is, to produce more individuals, according to the Nature of the Seed ; and therefore it shoots forth in Spires. But the Artist abuses the intention of Nature, and converts it to his own end, that is, to encrease the Spirits of his Malt.

The like is generally observed in Mines ; concerning which the Miners do assure us, that in most places they find them so hot, that they can hardly touch them : And for this heat we need not call for the help of the *Sun* or *Stars*, (as if they, by continual going round the Earth, did heat the same, and with their subtle Rays penetrate through its Veins,) which a little Cloud will take away from us, much more the Body of the Earth and Rocks ;
nor

now for *Subterranean Fire*: This *In-bred* heat being fully sufficient, to convert any apt Matter it meets with into its own *Species*.

I cannot but here observe, that in the late Wars, when many Castles and other old Buildings were dismantled and demolished, the Lead that was taken from off them was sold dearer than any other Lead; for divers Persons of Credit have affirmed, that it would yield very considerable Quantities of Silver; and the longer it had lain the more. Which is an evident Argument, that either by long lying, the Lead being the softer part, wasted away with the Sun and Weather, and so left more Silver in the same Bulk of Lead than it contained, when newer and fresher; or else that the Silver in the Lead (as all Lead contains more or less) did *Maturate* some part of the Lead, and convert it into its own more noble Nature (b).

I know not whether I should here mention the singular Opinion, or rather Fancy of *Senvertus*, who (c) attributed the Formation of Metals and Minerals to *Spirits*, who dwelt in the Mines for this purpose. He was perhaps led into this persuasion by the Reports that Miners have made of *Subterranean Spirits*; who say, they sometimes hear a *knocking*, or a noise like that, which their own Tools and Instruments do make. A Discourse of some-

(b) *Metallographia*, p. 71. (c) in his Book *de abditis rerum causis*.

thing of this Nature is printed by Mr. *Bushet*, which happened in the Mines at *Tallabout* in *Wales*.

And Dr. *Merin* tells us (*d*), he ask'd the Miners in *Hungary*, whether, whilst they are at work in those Subterranean solitary Places, they did not now and then see some Apparitions of Spirits or Dæmons? one of the Miners answer'd, that he had seen sometimes such like Dæmons in the shape of little *Negroe-Boys*; but that besides the first Fright, and a little prating to the Miners, they never did them the least harm, though sometimes they would extinguish their Lamps.

And Dr. *Brown* says (*e*), it is reported that a Spirit haunts the Silver-Mines at *Brunswick*, and that another is said to be in the Tin-Mines of *Slackenwalde* in *Bohemia*; and to walk in the shape of a *Monk*, who strikes the Miners, but does not hurt them, sings and plays on the Musick, and does many such Tricks. And *Agricola*, in the latter end of his sixth Book, *de re Metallica*, gives this for one Reason, why some Mines or Passages in Mines are given over and forsaken, *viz.* their being haunted by Spirits or Apparitions.

As to the *Material Cause* of Metals, it is commonly believed; that they are generated or compounded of *Mercury* and *Sulphur*; it be-

(*d*) In his Journey to the Mines of *Hungary*, in the 4th Vol. of the Collection of Voyages, p. 826. (*e*) in his Travels, p. 129.

ing experimentally known, that their ordinary mixture is with Sulphur ; and the abundance of Sulphur in Metals is an especial good sign of their Richness : A sufficient Instance whereof we have in the Rose-coloured Ore of the famous Mine of *Sancta Isabella* of new *Potosi*, in the rich Province of the *Lypes*, which is almost all Plate, and grows amongst such abundance of Sulphur or Brimstone, that the Cavities and hollow Places in the Rocks, are presently all on Fire, if a lighted Candle does but touch them (f).

And in the very same manner, is Mercury or Quick-silver found incorporated with Metals, although it be less taken notice of, being indiscernable in the Ore, as it comes out of the Ground : And when it is put in the Fire, the Mercury fumes away, and leaves no smell behind it, as the Sulphur does ; but its Effects are too much felt and experimented, by the mischief its Fumes do to those, who are employed in the melting of it. And for any one to say, that Mercury and Sulphur are not the Ingredients of Metals, and the matter of which they are compounded, because sometimes they are not to be met with in the Mines, is of no weight ; since as parts in the composition of Metals, they may have already lost their proper forms, and passed into the Nature of that Metal, which is made up of them (g).

(f) Barba's Art of Metals, p. 78 & 79. (g) *Idem* *ibid.*

(III)

And it is certain, there is so great an Affinity between the Nature of Mercury and that of Metals, though it be none of them, being a Mineral, that it is convertible into any of them, and may be extracted out of any of them, and most easily unites and incorporates with them : And its very substance is transmutable into true Metal, that will endure the trials of Fire and Hammer, as well as those Metals that come out of the Mine (*b*).

C H A P. XV.

Of the Growth of Metals.

MAny Persons do hold, that at the Creation of the World, God Almighty made the Veins of Metal in the same condition as we now find them at this day ; herein doing his Hand-maid *Nature* great wrong, and putting an affront upon her, by denying her a *productive* Vertue in this *matter*, which is allowed her in all other Sublunary things. For certain it is, that Metals were not at first created perfect, but only dispos'd in such sort, as that they should perpetuate themselves in their several Kinds (*a*).

And indeed, whosoever does but diligently consider the manner how most Metals do lie in their Wombs or Beds (which for the most part

(*b*) *Idem*, p. 139. (*a*) *Barba* of Metals, p. 71.

are hard Rocks, Cliffs and Stones, or things almost as hard as they, as *Lank* and *Spar*) must necessarily conclude, that they could never have penetrated the Cliffs, Chinks and porous places of such hard Bodies, but that before their entrance into those Cavities, they were in *principiis solutis*; either in the form of *Water* or *Vapours* and *Steams*: and that after their entrance they were endurated, concocted, and maturated into the several forms of Metals: Otherwise they could never be found in such streight Passages, narrow Places and Fissures, as all Experience doth testifie they are.

Besides, as when Men have extracted *Salt-peter* out of a Floor of Earth one Year, within three or four Years after, they find more *Salt-peter* generated in it, and do work it over again; so the same is observed in *Allum* and *Copperas*, and also in *Metals*: For when the Tanners in *Cornwall* have filled up their Pits with Earth, after they have wrought out all the *Tin* they can find in them; after *thirty* Years they have opened them again, and found more *Tin* generated.

The same is observed of the Iron-Mines of *Ilua* (an Island in the *Adriatick* Sea, belonging to the *Venetians*;) which, when they have dug as low and as deep as they can, the circumjacent Earth falls in and fills them up again, and in the space of *ten*, or *fifteen* Years at most, they work those Mines again, and thence draw out abundance of Metal, which
that

that new Earth has been converted into.

The same happens in the rich Mine of *Potosi*, where the Stones which the Miners had thrown aside some Years before, as worth nothing, afterwards produced abundance of Plate (*a*); and from the Earth, which they threw aside formerly, when they open'd those Mines, and made *Pits* and *Cross-ways* in the Hill, they have taken Silver, and found by this, that that Metal had been formed since that time (*b*).

Erastus affirms (*c*), that he did see, in the Mines of *Joachim* in *Bohemia*, Silver grown upon a Beam of Wood, which was there placed to support the Works.

There has been found in some of the Mines in *Germany*, *unripe* and *unconcocted* Silver, which the best Workmen affirmed, would have become *perfect* in *thirty* Years; who, when they find this *liquid* Silver, commonly say, *we are come too soon*.

We find by experience, that *bituminous* Earths have their increase, and Stones their growth and augmentation, and may well believe, that Metals and Minerals have the same.

That worthy and judicious Gentleman, *Mr. Boyle*, tells us from *Gerhardus*, that at *Anneberg* a *blew* Water was found, where Silver was yet in *primo ente*, that is, in its *first being*; which being coagulated, was reduced into the

(*a*) *Barba* of Metals, p. 71. (*b*) *Monsieur Acarete's* Description of the Mines of *Potosi*, p. 47. (*c*) *Metallogra.* p. 44.

Powder or Calx of fixed and good Silver (*d*). And *Lully* and *Mathesius* tell us, that *the matter* of Metals, before it be coagulated into a Metallick form, is like unto *Butter* made of the Cream of Milk, and when it is exposed to the Air, will quickly harden. And indeed many Learned Men are of Opinion, that all Metals and Minerals have been *Fluid*, before their coalition and concretion. Thus *Plato* thought, *ex aquis, quas fusiles apellamus, aurum compactum est* (*e*). Thus *Paracelsus* thought; for he saith, *Mirabili consilio Deus constituit, ut prima Materia Naturæ esset aqua, mollis, levis, potabilis, & tamen fructus ipsius est durus, ut Metallæ, &c.* (*f*). And to this agrees the Conclusion of *Sendivogius* *inde fit*, (saith he, speaking of the growth of Metals) *quod hodie reperiantur Minera in locis, ubi ante mille annos nullæ fuerunt* (*g*).

And *Mathesius* propounds and affirms these three things: (1st.) That Metals do grow and increase in the Veins of the Earth; (2^{dly}.) That one Metal did in time change into another, that was better: (3^{dly}.) That a perfect Metal, unless it be digged up, is consumed by the Subterraneous Fumes and Heat (*h*).

So that Mr. *Boyle* had good Reason to affirm, that Metals were not in the beginning produced at once altogether, but have been

(*d*) Sceptical Chymist, p. 360. (*e*) in *Timeo*. (*f*) de Mineral, p. 342. (*g*) *Novum Lumen Chymicum*, p. 314, (*h*) *Concio tertia Sareptana*.

observed to grow ; so that what was not a Metal or Mineral before, became one afterwards (*i*).

The Vegetability of Metals being thus very plain, may incline us the more to give credit to the Story of *Alexander ab Alexandro*, that in *Germany* there were a sort of Trees, called Vines, that brought forth Leaves and Branches of pure Gold, which were presented to great Princes (*k*).

C H A P. XVI.

Some Observations on Metals and Ores.

DR. Woodward observes (in his excellent *Natural History of the Earth*, Part 4.) that, in the *Mineral Kingdom*, there is nothing *regular, constant or certain* ; neither *colour, figure*, nor their *place*, or situation in the Earth, are to be trusted to, or relied upon, so as *positively* to make any Judgment from thence.

A common *Marchasite* or *Pyrites*, shall have the colour and brightness of Gold or Silver, and yet afford nothing but a little Sulphur and Vitriol ; whilst another Body, having only the resemblance of a Pebble or Stone, shall

(*i*) Sceptical Chymist, p. 357. (*k*) *Genialium Dierum*, p. 198.

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(*i*) Sceptical Chymist, p. 357. (*k*) *Genialium Dierum*, p. 198.

have a plentiful admixture of a valuable Metal in it.

Nothing is more common, than to find the same Metal shot also into very different forms and figures ; as well as to find different kinds of Metal of the same form and figure : And a Body, which has the shape and appearance of a *Diamond*, may prove upon examination, to be nothing but *Chrystals* or *Selenities* : Nay perhaps common Salt or Allum, naturally *Chrystallized* or shot into that form.

The same Metals are also placed indifferently in all kind of *Terrestrial Matter*, or in *Strata* of very different Natures ; so also as to their place in the Earth there is the same uncertainty : Sometimes we find them in the perpendicular Fissures or Intervals of the *Scrata* : (the far greatest part of the Terrestrial Globe consisting from its Surface downwards to the greatest Depth we either dig or mine, of several *Layers* or *Strata* of different kinds of earthly Matter, lying one over another, without any regular Order :) Sometimes interspersed in the Bodies of the *Strata*, and sometimes in both.

They are frequently also variously intermixed one with another ; so that 'tis a rare thing to find any of them pure and simple, but Copper and Iron shall be in the same Mass ; Gold and Copper, Silver and Lead, Tin and Lead ; yea sometimes all the six together in one and the same Lump.

'Tis

'Tis the same thing with *Minerals*; and Minerals and Metals are often blended and intermixed together.

Now the knowledge of this may be of great use to undeceive those, who are persuaded, that all things relating to Metals and Minerals, are transacted by Nature, in a most regular and accurate Order: Not but that Nature is sometimes regular in her Productions under Ground, as was said before *Chap. II.* But this is not to be expected or depended upon, except only in such places where frequent Experiments have confirmed the Observation.

So that the only standing *Test*, and distinguishing *Characteristick* of any Metal or Mineral, must be sought for, in the *constituent* Matter of it; and it must first be brought down to *that*, before any certain Judgment can be given of it: For many Persons have built great Hopes and been at great Charges upon several sorts of Fossils, which proved to be meer Stones of no worth. One sort of which, called *Marchasites*, have been fetch'd as far as from *America*, by some unskilful Persons, who from their ponderousness and glittering parts, usually of a Gold or Silver Colour, persuaded themselves, that they were Lumps of rich Ore of Gold or Silver.

Our own Chronicles tell us, that Sir *Martin Forbisher* brought from *China* and *Cathay* (to which he discovered the North-Passage) great store of a black soft Stone, supposing it to be

Gold or Silver Ore, which upon trial with great expence proved useleſs (a)

Mr. Boyle ſays, he cauſed ſome Lead-Ore to be tried, which being the moſt promiſing that he ever ſaw, made him ſuppoſe it might contain ſome conſiderable quantity of Silver: But though it proved ſo rich in Lead, as to yield after the rate of *ſeventy* Pound in the Hundred, yet one of the moſt expert Artiſts in *Europe*, could not extract *one* Grain of Silver out of it; whereas the Lead of very many Mines, being ſkilfully examined, will leave behind it upon the *Teſt* a proportion of pure Silver.

On the other hand; he tells us, that a Learned and Inquiſitive Friend of his, found in his Land a parcel of Ore; which to all that looked upon it, ſeemed to be Copper-Ore, and which did indeed after fuſion yield very good Copper. But the Perſons, to whom he committed the examination of it, being very inquiſitive and extraordinary ſkilful, found in that Ore beſides the Copper, no inconfiderable quantity of Silver; and in that Silver (having diſſolved it in *Aqua fortis*) a conſiderable proportion of Gold.

The ſame Gentleman, digging for more of that Ore, found a quantity of red Earth, which by knowing Mineraliſts was gueſſed to be but *Bolus*, and indeed look'd very like it. But being melted with *Regulus Martis Stellatus* by a

(a) *Stow's Chron.* p. 809.

skilful tryer of Metals, it divers times richly recompensed the Examiners Curiosity, by affording him many Grains of fine Gold.

A skilful *Dutch* Mineralist shewed the same *Mr. Boyle* a piece of a Mineral, which to him, and to the rest that looked upon it, seemed to be an ordinary and worthless *Marchasite*, in some parts of which, on which he had made trials, he found a rich proportion of pure Gold.

A very experienced Person in Metallick *Matters*, met with a sort of Tin Ore, which after a long digestion in *Lixivate* Liquors, afforded him a very considerable proportion of the richer Metals. insomuch that having a large quantity of that Ore, and finding the Experiment on it to succeed constantly, he promis'd to himself a vast Income by it. But when that stock of Ore was spent, the next that he procured, though with great carefulness managed, as the former, would by no means be brought to afford, either so considerable a benefit, or so much as any at all.

To the foresaid *Mr. Boyle*, was brought from *Ireland*, a piece of Lead-Ore, which finding so very light in the Lump, he thought it not at all worthy to be wrought for Lead. But afterwards upon trial, it appeared to be, though very poor in Lead, yet so well stored with *Corpuscles* of Silver, that he scrupled not to encourage the Owner to bestow pains and cost upon it.

He also tells us, that the Ores of Metals, are often found disguised in the form of *Earth* or *Mud*, easie to be dried or consolidated. That the best sort of *Swedish* Iron, is divers times found in the form of a *red Mud*, at the bottom of Lakes, or far less stagnant Waters: That he had found some *English Okers* (that pass but for red Earth or Stone of that colour) to be richer in Iron, than he found some famous Ores of that Metal to be.

Another experienced Writer (who gives an account of the Gold and Silver-Mines of *America*, among which he spent several Years,) takes notice, that Gold is found, from time to time, disguised in a reddish Earth, or is, tho' unsuspectedly, harbour'd in it.

An *Italian* Mineralist, *Vannochio*, who was of great repute in the last Age, also takes notice, that a reddish sort of Earth does sometimes contain a portion of the richest Metals.

And as Corpuscles of Iron are frequently discovered in a far greater variety of Fossils and Disguises, than even many noted Chymists would imagine, so Corpuscles of a *Golden* nature may lie concealed in divers Bodies, which are thought not to contain *any Metal*; and in those Ores, in which other Metals are manifestly *predominant*, there may be mingled pretty store of Particles of Gold or Silver; which (because of the greater quantity of that other Metal, which doth, as it were, cover and disguise them) lie unperceived, and usually unsuspected

suspected, by persons not very well acquainted with such matters ; and yet may, by one that is very skilful, be separated with profit.

A great *Virtuoso*, having procured a certain *American Mineral-Earth*, brought it to the *Publick Assay-Masters*, who thought it nothing worth, not being able by any means to bring it to fusion or make it fly away. But a certain *Mineralist*, having procured a little of it, tried it with a peculiar *Flux*, and separated from it near a *third* part of *pure Gold* (b).

Even from *Talk*, which is a sort of soft Stone (although some have been pleased to laugh at all attempts of separating any thing from any kind of it) pretty quantities of good Gold have been extracted (c). And therefore *Paracelsus*, after his Discourse of the great variety of Stones, *Marchasites* and other Minerals, concluded well (d). *Sed & hoc verum est, in terra multa adhuc condi, quæ mihi incognita sunt, sed eadem nec alii norunt, Certum siquidem est, progressu temporis tot tamq; varia a Deo adhuc proditum iri, de quibus nemo nostrum nedum unquam somniavit.*

There is also sometimes discerned a very great difference in the Ore of the *same* Mine, as to its richness or poorness in good Metals. So in the *Silver-Mine*, called the *Prince of Heaven* near *Frieberg*, the ordinary Ore is but poor,

(b) Mr. Boyle's Sceptical Chymist, p. 403. (c) his Physiological Essays, p. 53, 54, 58, 59. and his Hydrostatical way of estimating Ores, p. 166, 198, 201, 209. (d) de Mineral. Tract. 1.

holding an Ounce, or an Ounce and an half in an hundred Pound weight ; and yet not long since, there was Ore found in it so *rich*, as in an hundred Pound weight, to contain *sixty-five* Pound of Silver : but there was not much of it (e).

It is commonly said, that the Veins of Metal grow *richer* and *larger* the *deeper* they are wrought ; but this does not always hold ; Mr. *Waller* confessing, that the great Lead-Vein of *Est-kyr-kyr*, which was, at its first working, *eleven* Foot wide betwixt its firm sides, and *seven* Foot and a *half* in pure Ore, has not yet exceeded *seven* Foot and *six* Inches in Ore (f) ; nor the Ore (that I can find) grown richer in Silver. Besides, some Mines run not in any *settled* Veins, but in *Bellies* of Ore of all sizes : So do the great Lead-Mines of *Comestwith*.

There are also observable, some particular Qualities in the nature of several Metals, which make them differ not only from all others, but sometimes even from their *own* sort, in the manner of their Fusion.

So *Josephus Acosta* assures us, that the Metal of the Mines of *Porco* in *Peru* is easily refined with Bellows ; but the Metal of the Mines of *Potosi* in the same Country, cannot be melted with Bellows or any artificial Wind, but only by the natural Air or Wind : And therefore when they melt this Metal, they place their Furnaces

(e) Dr. *Browns Travels*, p. 134. (f) *Essay on the Mines*, p. 5. Description of them, p. 2.

on that side of the Mountain where the Wind lies. And though it be hard to yield a reason for this particular Property of the Metal, yet it is most certain, and approved by long Experience (g).

So *Flacourt* in his History of *Madagascar* tells us (h), That the Gold of that Country is of so very easie a Fusion, that it is almost as easily melted as Lead; whereas we here find the Gold we deal with, to require considerably strong Fires, and are wont to cast in *Borax* to facilitate the Fusion.

C H A P. XVII.

Of the Transmutation of Metals.

TRansmutation of Metals, is what the *Alchymists* call the *Grand Operation*, which is perform'd by melting any Metal in a Crucible, and then putting a little of the *Powder of Projection* into the melted Metal, which will be immediately turned into Gold or Silver, according as 'tis ordered (a).

Now as to this point.

The *Peripatetick* Philosophy declares the Transmutation of one Species into another, and particularly that of baser Metals into Gold,

(g) History of the *West-Indies*, b. 4. c. 5. (h) *Chap.* 37. (a) *Lexicon Technicum.*

to be against Nature, and physically impossible.

The *Corpuscular* Doctrine rejecting the substantial Forms and Elements of the Schools, and making Bodies to differ only in *Magnitude*, *Figure*, *Motion*, or *Rest*, and *Situation*, of their component Particles, which may be almost infinitely varied, seems much more favourable to the *Hermetick Doctrine*, of the possibility of working wonderful changes, and even Transmutations in mixt Bodies (b). But

The *Chymical* Philosophers go yet further, and do positively assert *the Transmutation of Metals*; and shew, that it is no such impossible, or wondrous thing, as many, that would seem wise and learned, do labour to persuade us. For *Calisthenes*, *Albertus Magnus*, and others, do affirm, that there is only *one* kind of perfect Metal, which is Gold; and that all other Metals are imperfect, and are but *the Principles* or *Gradations* unto that. So *Petrus Ferrariensis* saith, *Ad Aurum reliqua Metalla ordinantur, tanquam ad finem*: Another Author thus, *Natura semper proposuit & contendit ad perfectionem auri* (c); It is Nature's ultimate Labour and Intention to bring all other Metals to the Perfection of Gold: So that they conceive it feasible to reduce them to perfection and turn them into Gold. For this they tell you, Nature of her self would accomplish in time,

(b) Mr. Boyle's Preface to his Essay on Salt-Peter. (c) *Speculum Alchymie*, c. 2. p. 258.

did not Men dig them out of the Bowels of the Earth, before they be come to their full Maturity ; for Metals do not differ from one another *specifically*, but only *gradually*, some of them standing (as 'twere) in an *intermediate way*, and wanting only the due height of concoction : For there are *Sulphur* and *Mercury* equally perfect in other Metals, as well as in Gold, only it is in imperfect Metals infected or contaminated with Terrestrial Feculency, or combustible Sulphur, which are extraneous and adventitious to it. So that this Transmutation seems to be easy ; for 'tis only removing the *Heterogeneous Matter* or *Scoria*, and adding some of the *Tincture*, by which the Parts are most closely joyned and united *per minima*, and tinged ; and so matured in a short time by the help of Art, which Nature of it self could not have performed under many Years (*d*).

They, who oppose the possibility of this Experiment, place the force of their Argument in proving, that the several *Species* of Metals are compleat in themselves, and distinct one from another ; and that therefore a transition from one to another is impossible.

But to this it is said, that we cannot conclude two things to differ in *Specie*, because the same definition agrees to them both, unless the *essential* difference, that constitutes them such, be shewn therein : As if one should assert a *Man* and a *Lyon* to be Animals, he could not

(*d*) *Metallographia*, p. 378.

infer from thence, that they are of different *Species*; for so *Peter* and *Paul* would be distinct in *Specie*, were it not for the difference of *rational* and *irrational*, that limits the *Genus*. So that although the definition of Metal does agree unto *Lead* and *Silver*, as well as unto *Gold*, yet one cannot from thence rightly infer, that they differ *specifically*. because the one may be *perfect*, as *Gold*; and the other *imperfect*, as all the baser Metals are. Thus, *Barba* says (e), a Child and a Man have the same definition, the Child may grow up to *perfection* and become a Man.

As for that *permanency*, which Metals seem to have in their particular kinds in the Earth, (which by some is made an Objection against this *Hypothesis*) that proceeds, they tell you either, (1.) from the slowness of their Growth and Melioration, which falls not within the compass of humane Observation, like the Growth of Vegetables; which after some space of time, we can discern to be increased; or (2.) from their being digged out of the Earth, before they be come to their full Maturity (f).

Again, Metals being frequently found in the Earth variously intermixed one with another, as *Gold* and *Silver*, *Gold* and *Copper*, *Silver* and *Copper*, *Silver* and *Lead*, &c. and the Veins of Metal in the Mines, sometimes changing from one sort into another, as the Veins of

(e) Art of Metals, p. 83. (f) *Idem*, p. 84.

Copper into those of Gold or Silver, of Lead into Silver, &c. is made by some an Argument of the affinity there is between the Matter of Composition of Metals, and that the greater or lesser Purification, is the only difference between them (g).

The changing also of the *inferiour* Metals into one another, which is affirmed by many Philosophers, not only to be very feasible, but to have been frequently done by *Art*, shews the possibility of *this* more noble Transmutation. Thus Iron or Steel, Lead or Tin may be turned into most pure Copper, and Copper into Silver, and Silver into Copper (h).

Now this *Grand Secret* in Nature, the *Physical Tincture* or *Elixir*, has been known but to few Persons in the World, viz. to the *Rosycrucians* or *Adepti* (as they call themselves) who have used it very sparingly to what they might have done; but *some* use they have made of it.

Thus *Paracelsus* transmuted a Piece of Copper into Silver (i), and teaches a way to make an Oil, called *Epatica Sulphuris*, which turns Silver into Gold (k).

Basilus Valentinus, in his *Triumphant Chariot of Antimony*, teaches a way, how to make

(g) *Idem*, p. 124. (h) *Idem*, b. 2. c. 9. and *Lazarus Erckern* of Ores and Mineral Bodies, b. 3. c. 14. (i) *Collection of Voyages*, Vol. 4. p. 822. (k) *Barba's Art of Metals*, p. 38.

of that Mineral a *Fire-stone*, as he calls it, that will turn other Metals into Gold (l).

Raymundus Lullius, in a Book called, *Disquisitionis Heliana*, teaches several ways how to turn Mercury into Gold and Silver (m).

Van Helmont projected one fourth part of a Grain of the *Gold-making-Powder* upon eight Ounces of *hot Quicksilver*, and it produced eight Ounces of pure Gold, wanting eleven Grains (n).

Sir *Edward Kelley*, when he was in *Germany*, by virtue of *this* Secret, ranted in his Expences (say the Brethren of his Art) above the Sobriety befitting so mysterious a Philosopher, giving away, at the Marriage of one of his Maid-servants, in Gold-Rings to the value of four thousand Pounds (o). For he and Dr. *Dee* had the good fortune to find a large quantity of the *Elixir* in the Ruins of *Glassenbury-Abbey*, as a famous *Rosycrucian* and *Virtuoso* relates (p). This *Elixir* was so surprizingly rich, that they lost a great deal in making Projection, before they discover'd the force of its Virtue. This *Author* adds, that at *Trebona* in *Bohemia*, Sir *Edward* tried a Grain of this *Elixir* upon an Ounce and a quarter of common Mercury, which was presently transmuted into almost an Ounce of fine Gold. (q) At another time he made Projection up-

(l) *Ibid.* (m) *Idem*, p. 139. (n) *Metallographia*, p. 371. (o) Dr. *Fullers* Worthies of *England*. In his Account of Sir *Edward Kelly*. (p) *Elias Ashmole* Esq; in his *Theatrum Chymicum Britannicum*, p. 81. (q) *Idem ibidem*.

on a piece of Brass cut out of a Warming-pan, which without handling or melting, was turned into very good Silver, only by warming it at the Fire, and putting the *Elixir* upon it. This Warming-pan and the piece taken out of it, was sent to Queen *Elizabeth* by her Ambassador then residing at *Prague* (r).

The same Author tells us (s), that an *English* Gentleman of good Credit reported, That in his Travels abroad, he saw a Record in the Isle of *Maltba*, which declares, That Sir *George Ripley*, a famous *Alchymist*, gave yearly to the Knights of *Rhodes*, one hundred thousand Pounds toward maintaining the War (then on foot) against the *Turks*.

The learned Dr. *Dickenson* tells the World, (t) He was twice shewed this mighty Feat (of Transmutation) by an *Adept*, that went by the name of *Mundanus*.

Dr. *John Kunkell*, Chymist to the Elector of *Saxony*, assures us, that a certain Salt of Metals was known to him, by which Mercury might be fixed into Silver (u).

The *Sieur Dumont* gives an account (w), of two *Persian Dervices*, or *Mahumetan Priests*, who came to *Constantinople* in the Year 1687, where after they had staid a Fortnight, they told their Landlord, that though they had no Money to pay for their Lodging and Entertainment, they were resolved not to go away

(r) *Idem ibid.* (s) *Idem ibid.* (t) in his Book de *Quintessentia Philosophorum* (u) *Pyrotechnical Discourses*, p. 166. (w) In his new Voyage to the Levant, p. 313.

without giving him entire satisfaction : Here-upon they took a large *Copper-Dish*, which they found in the House ; and having melted it down in his Presence, threw a little Powder upon it, which immediately changed the *Copper* into *Silver*. Of this they retained one half to themselves, and left the other with their Landlord, who upon tryal found it to be *True Silver* ; and besides they presented him with a small Quantity of the Powder. The Grand Visier *Ismael*, hearing of this accident, sent for the Man, and obliged him to deliver up the Powder ; which he shewed to several expert *Chymists* ; who, according to his Orders, endeavoured to find out the Secret, but were not able to do it.

The Prince of *Mirandola*, in his Treatise de *Auro* (x) affirms, that he knew a certain Person, *qui Aurum & Argentum sæpius effecit per Artem*.

Mr. Boyle was assured by a very credible Foreign Physician, that he and another Person, did diversetimes turn *Silver* into perfect *Gold* (y) The same noble Person tells us, that *Dr. K.* a Person far both from the Temptation and Custom of Lying, assured him, he did once light on a kind of *Aqua-fortis*, with which he did several times draw a *volatile Tincture*, which could and did turn *Silver* into *Gold* ; and that out of an Ounce of *Gold*, he drew as much of this *Tincture*, as did transmute an

(x) *Lib. 3. cap. 6.* (y) *Physiological Essays, p. 76.*

Ounce and a half of Silver into that more noble Metal. This Mr. Boyle believes to be possible, because he himself was able more than once to deprive Gold of its *yellow* colour, and to communicate it to a *Menstruum* (z).

The same Mr. Boyle says moreover, that he was certified by the Observations of Men very experienced in Metalline Affairs, and by *his own*, that Silver has in it a *Sulphur*; which Maturation is capable to graduate into Gold (a).

In another place (b), the said eminent and learned Mr. Boyle has these Words. 'We are told that there lives concealed in the World, a Sett of *Spagyrist*s, of a much higher Order than those, that are wont to write Courses of *Chymistry*, and other Books of that Nature; being able to transmute *baser* Metals into *perfect* Ones, and do some other things, that the generality of *Chymists* confess to be extremely difficult, and divers of the more Judicious, even among the *Spagyrist*s themselves, have judged impossible. For *my* part, I shall not deny, but that what I have heard from divers very credible Eye-witnesses and perhaps some *more immediate* Arguments, do strongly incline me to think, that there may have been, and may yet be some such Men. And whatever be thought of what they call,

(z) *ibid.* (a) *ibid.* cui consensit Antonius Mirandulanus Philosophus in illo suo Opere, quod scripsit de Eversione singularis Certaminis, lib. 19. Sect. 7. (b) *viz.* in the Preface to his Appendix to the Sceptical Chymist: Of Mr. Boyle's Opinion is Janus Lacinus in Cardan lib. 17. de Subtilitate.

' *The Philosophers-Stone*, I confess my self con-
 ' vinced by what I have seen, that there are in
 ' the World, as difficult *Arcana*, as divers of those
 ' which have been (perhaps not all of them
 ' justly) derided under the Name of *Chymical-*
 ' *Non-entia*. And if there be really such *Adept*
 ' Philosophers, as we are told of; and which
 ' I think not incredible: I am apt to think,
 ' that among their other *Arcana*, they are
 ' Masters of some *Alcahestical*, or other ex-
 ' tremely potent *Menstruums*; and may, by
 ' the help of these and other means and ways,
 ' peculiar to themselves, of penetrating and
 ' working upon mix'd Bodies, be able to pro-
 ' duce in them such alterations, as we have
 ' few or no Examples of.

' The same worthy Person tells us, in ano-
 ' ther place (c), that by putting to a Calx of
 ' Gold, a good Portion of his *Menstruum per*
 ' *acutum*, with a little Spirit of Salt, it did
 ' slowly and quietly dissolve it; only at the bot-
 ' tom remained a white Powder, which the
 ' *Menstruum* would not touch, and which was
 ' indissoluble in *Aqua Regalis*. This white
 ' Powder being with *Borax*, or some such Flux-
 ' powder melted into a Metal, was found to be
 ' white like Silver, yielding to the Hammer,
 ' dissoluble in *Aqua-fortis*, or Spirit of *Nitre*;
 ' and would there leave a Silver-calx odiously
 ' bitter.

(c) In his Origin of Forms, p. 235.

This (says the ingenious Dr. Harris (d)) is a *strange* Experiment, which had Mr. Boyle made any more then once, as I cannot find that he had; and had he tryed the *specifick* Gravity of this apparent Silver, and found it to be less than that of Gold, it had been no small proof of the possibility of a Transmutation of Metals.

Now as to the way or manner, how this famous Transmutation is to be performed, the *Adepti* tell you (e), it must be done by some one of these three ways, or by two of them, or by all together: Either (1st.) by adding something to the thing or subject to be changed, which it had not before; or (2^{dly}.) by taking away and separating from the Subject, that which was in it before; or (3^{dly}.) by reason of *Motion*, so to order, dispose and alter the contexture of the Parts, that thereby it appears another thing, to what it was before. So that there is added in the *Grand Operation*, some small part of the *Philosophers Tincture* unto the Metal, that is to be changed, which gives or joyns to it, some Particles, which it had not before; and there are separated from it such *Heterogeneous* Particles, as were before contained in its porous Parts, and which hinder'd the *Homogeneous* ones from being closely joyned together *per minima*; but which are now extruded by the ingression of a small quantity of the *Tincture*: And when a

(d) *Lexic. Technic.* (e) *Metallograph.* p. 367.

softer Body is changed into a harder, or a fluid Body into a firm one, the parts are joyned more close together; and it is well known, that all Motion in Bodies, must of necessity make a change of the *Position, Contexture* and *Order* of the Parts.

If it seem strange to conceive, how the weight of the transmuted Metal can be so much increased, as it must be in this case, by the addition only of a light *Tincture*, or *Powder*; one Grain of which is said to be able to turn a whole pound of *Mercury* into *Gold* or *Silver*; Mr. *Boyle* will tell you (f), that he sees no impossibility in it, but that the *specifick Gravity* of *Metalline* Bodies, may be encreased or diminished, by such small proportions of *Additaments*, as do not at all add to their *absolute Gravity*; as on the contrary a Metal may be made far lighter in *Specie*, than it naturally is, by the addition of far less than a hundredth Part of its weight.

But against all this that has been advanced in favour of *Alchymy*, many learned Men say, that *this Art* is a meer cheat, and that the *Adeptists* amuse the ignorant and unthinking part of Mankind, with Cant, hard Words, and Non-sense; (and indeed *Geber* confesses in the name of his Brethren, *ubicunq; aperte locuti sumus, ibi nihil diximus* (g)) and that were it not for the *Arabick* Particle *Al*, which they will needs have to be of wonderful

(f) In his Appendix to the Sceptical Chymist, p. 186. (g) *Arcanum Hermeticum*, p. 168.

Vertue here, the Word would signifie no more then *Chymistry* (h).

That this study of *Alchymy*, has been rightly defined to be, *Ars sine Arte*, *cujus principium est mentire, medium laborare, & finis Mendicare*, i. e. an Art without an Art, which begins with Lying, is continued with Toil and Labour, and at last ends in Beggary; and that so poor Penotus found it, who after he had spent his whole Life and Fortune in this vain Study, died at last in an Alms-House at Yverden in Switzer-land; and used to say, he would recommend the Study of *Alchymy* to a mortal Enemy, whom he did not dare to attack openly (i).

That of these mystical and invisible Gentlemen, there are twelve always said to be in being, which are kept supplied by new ones, when any of the Fraternity pleases to die, or to translate himself to some other place, where he can make use of his Gold; for in this wicked World it will not procure them Shirts (k).

That you have in Lemery, Dr. Dickenson, and others, long accounts of the Impostures and Cheats of several pretended Adepti; how they fix Mercury with Verdegrease, and then colour it deeper (for the Verdegrease will give it a yellow Colour) with Turmeric, Cadmia, &c. and then they would pass it thus off for true Gold; but if you should go about to try

(h) Lexic. Technic. (i) *ibid.* (k) *ibid.* (*Alchymiam vanam esse & species metallorum transmutari non posse, asserunt Avicenna in Commentariis, Averroes in lib. de Generatione. Egidius in. 3. Quotilibato. quest. 8.*)

it by the *Cuppel*, it will all fly away in Fumes (1).

And therefore nothing produced this way, ought to be adjudged true Gold, unless it have all the Properties of true Gold, (for all is not so that glisters and looks yellow) that is, it must be able to endure *Copelling*; *Cementation*, *Purification* with *Antimony*, and the *Depart* (m). It must have the *Malteability*, and great *Ductility* of that Metal; and especially its true *specifick Gravity*; i. e. it must be to Water, as nineteen or eighteen and half is to one, or else 'tis some way false and counterfeit; for let it look how it will, if it have *less specifick Gravity*, than eighteen and one half to one, it cannot be true Gold, but must either be a mixture of some Gold, and other Metals together, or else some of them under the disguise of Gold (n).

But the making of false Gold must not be charged *only* upon the *Alchymists*, it being too much practised by others, especially by the *Negroes* of *Guinea*, who cheat all the Ships they can that come to Trade there, by putting false and counterfeit Gold upon them; a Fraud which they have frequently practised; as they did lately upon two small *English* Ships; one of which was laden to the value of 1700 l. sterling; for all which the Master received only false Gold; the making of which is here so

(1) *ibid.* (m) What these are see, Chap. 7. (n) *Lexic. Technic. Exempla Fallacis Alchymia vide apud Cardanum in 1o lib. de varietate Rerum, cap. 51.*

common, that it is publickly sold, and become a perfect Trade; the Price current being about a Crown in *good* Gold for two pounds of *false*: One sort of false Gold frequent amongst them, is nothing else but a certain Powder of *Coral*, which they cast and *tinge* so artificially, that several unexperienced Traders, are often cheated with it, and by dear-bought experience taught, how to know *true* Gold (o).

And as the *Negroes* put that off for Gold, which has no Gold in it, so they are very subtil Artists, in *sophisticating* of true Gold, and mixing it with other Ingredients, which makes it so little worth, that it will not sell in *Europe* for above forty Shillings the Ounce: They also give a very good Tincture to the Filings of Copper, and make them pass for *Gold-Dust* among the *unskilfull* (p).

But to return to the Art of Transmutation; which whether it be true or false, there has been a Tradition of such a Thing for some hundreds of Years; and it has been talk'd and writ of for many Ages.

Thus we are told, that *Morienus*, a *Roman* Hermit, whose Writings were translated from the *Arabick* Tongue into Latin *Anno Christi* 1182, Learned the Art of Transmutation or of the *Great Elixir* of *Adfar*, an *Alexandrian* and a Christian, and afterwards taught it to

(o) *Bosman's Description of Guinea*, p. 15. (p) *Idem*, p. 82, Where you may see the (infallible) way, that skilful Merchants use to prevent the Reception of false Gold.

Calid or *Evelid*, the Son of *Gizid*, King of *Egypt*. This *Adfar*, it is supposed, learned the *Art* from the Writings of *Hermes Trismegistus*, a very ancient Writer on this Subject (q).

Dioclesian the thirty-eighth Roman Emperor, caused to be gathered together and burnt all the Books among the *Egyptians*, that treated of *Chymistry*, lest growing rich by the Art of Transmutation, they should be encouraged to rebel (r).

Henry VI. King of *England*, in the 24 Year of his Reign, granted a Patent to *Sir Edmund Trafford*, and *Sir Thomas Ashton*, Persons (of high esteem, anciently descended, and richly revenue'd in *Lancashire*) greatly skilled in *Chymistry*, *Metalla imperfecta de suo proprio genere transferre, & per artem in aurum, sive argentum perfectum transubstantiare ad omnimodas probationes & examinationes, sicut aliquod aurum, sive argentum in aliqua Minera crescens, &c. i. e. to translate imperfect Metals from their own kind, and by Art to turn them into such perfect Gold or Silver, as will bear the same proof or tryal, with any Gold or Silver growing in the Mine* (s).

The same King (as *Mr. Prynne* tells us, in his *Aurum Regine*) in his 34 Year, did by the Advice of his Council and Parliament, grant four successive Patents and Commissions, to several Knights, Citizens of *London*, *Chymists* and

(q) *Metallogra.* p. 15. (r) *Libanii Alchym. Transf. Defensio.* p. 214.

(s) *Dr. Fuller's Worthies of England.* p. 122.

Monks (with a *Non-Obstante*, to the Law of *Henry IV.* against multiplying of Gold and Silver,) to find out the *Philosophers-Stone* or *Elixir*, that would transubstantiate other Metals into most true and solid Gold and Silver. And in his 35 Year he granted new *Letters Patents*, to ten several Persons of eminent Quality (therein mentioned) to judge and certify to him, whether the thing were practicable or no; and whether it would conduce more to the hurt or good of the Kingdom. But it seems *Mr. Prynne*, with his indefatigable Labours, could not find any Report upon the *Patent*, whether or no the *Elixir* was found out, or whether the King's Debts were paid thereby, or else he reserved that secret to himself (t).

I find in *Poulton's Statute-Book*, that an Act of Parliament was passed in the fifth Year of *Henry IV.* in these Words.

Item, It is Ordained and Established, that none from henceforth shall use to multiply Gold or Silver, nor use the Craft of Multiplication; and if any the same do, that he incur the Penalty of Felony in this Case.

It seems, many great Persons, about this time, had spent their Estates and ruined themselves and their Families, in attempting the *Art of Transmutation*; and therefore this Act was passed to put a stop to that practice.

(t) *Fodine Regales*, p. 44.

I do not find any one prosecuted upon this *Statute* till the seventh of *Edward VI.* when one *Eden* confessed himself guilty of *Multiplication*, viz. that he had practised to make the *Fifth Essence*, whereby all Metals may be made Gold or Silver : He accused one *Whalley* (then Prisoner in the Tower) that he did move and procure him to practise that *Art*. But a *General Pardon* being passed at that time, in which *Felony* was included, *Eden* escaped, though *Whalley*, as accessory to the *Felony*, did not as being one of those, who were in the Tower, who were excepted from Pardon (u).

The foregoing Statute was made void, and repealed, in the first Year of King *William* and Queen *Mary*, to the great joy and satisfaction of the *Spagyrist*s and Lovers of the *Pyrotechnick Art*, to whom this Law was before a discouragement and terrour (w).

I shall conclude this Chapter with the Judicious Determination of the Learned Mr. *Watton*, in these Words (x).

‘ I must needs say, I cannot tell what Judgment to make of this Art of transmuting Metals into Gold ; the Pretences to inspiration and that Enthusiastick Cant, which run through the Writings of almost all the Alchymists, seem so like imposture, that one would be tempted to think, that it was only a design carried on from Age to Age to de-

(u) *Dyers Reports*, p. 88. (w) See chap. 6. (x) In his *Reflections upon Ancient and Modern Learning*, p. 131.

' lude Mankind; and it is not easie to imagine
 ' why God should hear the Prayers of those
 ' that desire to be rich. If, as they pretend, it
 ' was Zeal for the Good of Mankind, that
 ' made them take such pains to find out
 ' such noble Medicines, as should free Men from
 ' the most obstinate Diseases, to which our Na-
 ' tures are subject, why do they not commu-
 ' nicate them, and leave the *Process* in Writing
 ' plainly to Posterity, if they are afraid of dan-
 ' ger to themselves? Concern for the Welfare
 ' of Mankind, and affected Secrecie, seem here
 ' inconsistent things. Men of such mortified
 ' Tempers and publick Spirits, ought not to be
 ' concerned, though Gold or Silver were made
 ' as common as Lead or Tin, provided that the
 ' *Elixir* which should remove all Diseases
 ' were once known.

' Though these are reasonable Prejudices a-
 ' the belief of the Truth of this Operation,
 ' yet one can hardly tell how to contradict a
 ' Tradition so general and so well attested. So
 ' many Men (methinks) could not have cheat-
 ' ed the World successfully for so many Ages,
 ' if some had not been sincere. And to use a
 ' Proverb in their own way, *So much Smoak*
 ' *could scarce have lasted so long without some*
 ' *Fire*. Till the seminal Principles, from which
 ' Metals are compounded, are perfectly known,
 ' the possibility of the Operation cannot be
 ' disproved; which Principles, as all other
 ' real Essences of things are concealed from us.

' But

‘ But as a wise Man cannot perhaps without
 ‘ rashness disbelieve what is so confidently as-
 ‘ serted, so he ought not to spend much time
 ‘ and cost about trying whether it will succeed,
 ‘ till some of the *Adepti* shall be so kind, as to
 ‘ give him the *Receipt*.

I shall only remark, that whosoever shall
 aim at the *Philosophers Stone*, *Elixir*, *Powder*
of Projection, or *Pantarva* (which all signifie
 the same thing,) according to the agreement
 of *all* Writers thereon, they must be Men of
upright, *good* and *pious* Lives, free from *Vice*
 and *Vanity*, Practisers of all Moral Vertues,
 Contemners of the World, such as only study
 the *publick Good* of others, and not the enrich-
 ing of themselves. From such as these there
 is no fear of danger, because their study is on-
 ly to do good, and not to *deceive*. Nor in-
 deed is there much danger from any others,
 who under pretence of gaining or having this
Rarity, when they are not really Masters of it,
 do but delude themselves and others, because
 their Impostures may easily and soon be dis-
 cover’d by *skilful Refiners* (y). And therefore
Thomas Aquinas (z) and *Pererius* (zz) need not
 be so much concerned, as they are, lest the
Publick should suffer by the Study and Practice of
Alchymy, since they are no *true Alehymists*,

(y) *Fedin. Regal.* p. 45. (z) *In Secunda Secunda; Quæst.* 77.
Artic. 2. & *Senten.* di. 7. qu. 3. (zz) *In lib. 8. de principijs Re-*
rum Naturalium.

but Cheats and Impostors, that make or vend false Gold or Silver.

C H A P. XVIII.

Of G O L D.

BArba gives the following account of *Gold*.
 The most perfect of all inanimate Bodies, and the most esteemed of all Metals is *Gold*, universally known and coveted by all people. It is made of the same matter, and in the same manner, as other Metals are, but of parts so pure and perfect, and so well compacted together by Concoction, that its Substance is, as it were, *incorruptible*, not any of the Elements having power to corrupt or destroy it. The Fire, that consumes all other Metals, only makes Gold more pure: The Air and Water diminish not its Lustre, nor can Earth make it rust or waste. By the Nobleness of its Substance it has most deservedly obtained that Estimation which the World gives it; and by the natural Virtue which flows from the admirable equality of its Composition, it's said to be the best Medicine in the World against Melancholy, and the greatest Cordial to the Hearts of Men, which perpetually bend towards, and turn to this *Avaritious* Metal, as the *Needle* doth to the *Loadstone* (a).

(a) Art of Metals, p. 108.

The Virtue ascribed to *Aurum Potabile*, to preserve a Body perpetually in Youthfulness, and without Infirmary, together with the Receipt of making it, depends upon the Credit of those *Authors*, who have writ concerning the same (b).

There are two sorts of Gold produced by Nature.

[1.] That which is called *native* Gold, which is pure and unmixt with any *heterogeneous* Matter; and this is frequently found in the Sands of Rivers, in the Earth, and in the Mines.

So *Basilus Valentinus* tells us, that perfect, pure, and compact Gold is found in *Hungary* in the white Marble, which may be easily broken (c). So Mr. *Boyle* tells us from *Acosta*, that pieces of *native* and *pure* Gold have been found, that weighed many Pounds (d).

The same *Acosta* informs us, that in *America* Gold is got after *three* ways; for they find it either in *Grains*, in *Powder*, or in *Stones*. They call Gold in *Grains*, small Morsels of Gold, which they find whole, without mixture of any other Metal, and has no need of melting or refining in the Fire; they also call them *Pippins* for that commonly they are like to *Pippins* or Seeds of Melons or Pumpions; though sometimes they find much bigger pieces, even of several hundred pound weight (e).

(b) *Idem ibid.* (c) *Last Will and Testam.* c. 12. p. 27. (d) *Sceptical Chymist*, p. 372. (e) *Natural History of the Indies*, f. 212.

The purest Gold that we have is the *Sand-Gold* brought from *Guinea* and some other places, which is so near pure and unmix'd with any other Metals, that the Artificers, who make Leaf-Gold, and those who draw Gold into small Wyre or fine Threads, do commonly buy it, because it will serve their uses, without the *Aqua Separatoria*; and so they do the old Gold coined by *Edward III.* because it has in it the least Allay of Silver or Copper (f).

The greatest quantity of Gold that is got in *America* is that in *Powder*, which they gather thus, near *Sancta Maria* in the *Isthmus* of *Darien* (g). The *Spaniards* there keep a great many *Blacks* or *Negro-Slaves*, who have little wooden Dishes, which they dip softly into the Water of the River, and take it up half full of Sand, which they draw gently out of the Water; and at every dipping they take up Gold mixed with the Sand and Water, more or less: This they shake and the Sand rises, and goes over the brims of the Dish with the Water, but the Gold settles to the bottom. This done, they bring it out, and dry it in the Sun, and then pound it in a Mortar; then they take it out and spread it upon a Paper, and having a Load-stone they move that over it, which draws all the Iron, &c. from it, and leaves the Gold clean from Ore or Filth, and the Gold is then bottled up in Calabashes. In this manner they work, during the dry Season, which is about three

(f) *Metallographia*, p. 152. (g) *Waser's Voyages*, p. 24.

Months ; for in the wet-time the Gold is waſhr-
ed down from the Mountains by violent Rains,
and then commonly the Rivers are very deep ;
but in the dry and gathering Season, when
they are fallen again, they are not above a
foot deep.

In the Year 1680 *April* 12. there was car-
ried *three hundred* weight of Gold to *Panama*
in a Bark, which is ſent from thence twice or
thrice every Year, to fetch what Gold is
brought to *Sancta Maria*, from the Rivers and
the Mines (*b*).

So alſo on the Main-land over-againſt the
Iſland of *Gorgona*, which is ſituate in the
South-Sea, there is an *Indian* Town, where
they have great quantities of Sand-grains of
Gold, gathered from the Neighbouring-River ;
and at a good diſtance from the Town up the
River, dwell four *Spaniſh* Super-Intendents,
who have each of them the charge of over-
ſeeing fifty or ſixty Slaves, who are employed
in gathering that Gold, which ſlippeth from
the Chief-Collectors or Finders thereof ;
which Chief-Collectors are at leaſt threeſcore
and ten or fourſcore *Spaniards* (with a great
number of Slaves belonging to them) who
dwell higher up, than theſe four Super-Inten-
dents, at the diſtance of ſome Days ſailing on
the ſaid River. And once every Year, at a
certain Season, there comes a Veſſel from *Lima*
the Capital City of *Peru*, to fetch the Gold
that is thus gathered, and to bring theſe Peo-

(*b*) History of the *Buccaniers* of *America*, Part 4. Chap. 3.

ple such necessaries, as they want (i).

So in *Guinea* in *Africa* (k) after violent showers of Rain in the Night, next Morning the Rivulets and Water-falls are sure to be visited by hundreds of *Negrœ-Women* to seek for Gold; which is Here of two sorts; one is called *Gold-Dust*, which is found in the Rivers, and after it is cleansed from Earth and Sand, is almost as fine as Flower, and is the best, bearing also the greatest Price in *Europe*: The other sort is in Pieces of different sizes; some being hardly the weight of a Farthing, others weighing as heavy as twenty or thirty *Guineas*; though of the last sort not many occur; and these Lumps or Pieces are called *Mountain-Gold*, being found in the Pits within Land, where they dig for it.

But besides the Gold that is gathered from the Rivers, there is a great deal digged out of the *Mines*; especially those of *Sancta-Cruz de Cana* near the said Town of *Sancta Maria*. To these Mines a Body of *English-men*, to the number of four hundred and eighty two made an Expedition from *Jamaica* in the Year 1702. but the *Spaniards* having had notice of their approach, were retired with all their Treasure into the Woods, only some *Negroes* remained, whom they set to work in one of the Mines, which was above thirty Yards deep: The Ore they dug out of it was a sort of a Mixture of Rock, which was brought to the Mill and ground small, then washed and made up into

(i) *ibid.* Chap. 10. (k) *Bosman's Description of Guinea.* p. 81.

the form of Bricks : After this it is washed a second time, and so cleared of the Dross or some Rocky part, where with it is intermixed till there remains pure Gold. Thus they make a great quantity of Gold every Day they work. While the *English* were there, they made *five Pound weight* and *nine Ounces* in less than a Day ; another Day they made *six Pound weight* ; the third Day twenty four *Negroes* bound *eight Pound weight* from the Mine ; the fourth Day they made *fourteen Pound weight*, as they did *sixteen* on the next. In short, during the few Days they continued there, they got about *eighty Pound weight* of Gold out of that Mine (l).

There are also many *Gold-Mines* near the great City of *Quitto* in *Pern*, from whence much Gold comes yearly to *Lima* in Barks, by the way of *Guayaquil*, which is the *Embarcadero* or Sea-port to the City of *Quitto* (m).

[2.] The other sort of Gold, besides that which is called *Pure* or *Virgin-Gold*, is that which is melted or *extracted* by the force of Fire out of other Metals, that it is mixed with. For *Acosta* tells us, that *Gold* is commonly found mixed with *Silver*, or with *Copper* ; but that which is mixed with *Silver* is commonly of fewer *Carats*, than that which is mixed with *Copper*, and not of so high a value (n). It is also sometimes found mixed with Stone,

(l) Capt. *Davis's Expedition to the Gold-Mines*, in *Waser's Voyages*, p. 280. (m) *History of the Buccaneers of America*, p. 59. (n) *Acosta History*, p. 143.

which *Acofta* describes thus : ‘ Gold in Ston-
 ‘ is a Vein of Gold, that groweth or ingene-
 ‘ dereth within the Stone or Flint ; and the
 ‘ Gold, which grows in this manner, is found
 ‘ in Mines, which have their Veins like to
 ‘ the Silver-Mines, but it is very hard to draw
 ‘ it forth. In the Mines of *Curuma* very great
 ‘ Stones were pierced, that were intermix’d
 ‘ with Gold ; others were half Gold and half
 ‘ Stone.

C H A P. XIX.

Of S I L V E R.

Silver, as *Barba* notes (a), is the most perfect
 of all Metals, except Gold, and the good
 mixture and fineness of its parts makes it to
 endure the Fire with very little waste ; it is
 also tough and malleable, and will be drawn
 out into very thin Leaves and small Wyres ;
 so that, were it not a common Trade to do it, it
 would not be believed to be possible, that one
 Ounce of Silver should be drawn out into
 1400 Yards of Wyre ; and it is yet more
 wonderful, that all *this* shall be made Gilt-
 Wyre with only six Grains of Gold ; so that
 although Silver can be extended to admiration,
 yet Gold is a hundred times more Ductile.

A diligent Observer tells us (b), the Mines
 of Silver are commonly found in *Moun-*

(a) Art of Metals, p. 113. (b) *Acofta* in his History, p. 201.

tains and *high Rocks*, although they have been sometimes found in the *Plains* and *Champion*. There are two sorts of it, the one they call *stragling*, the other *fix'd* and settled: The *stragling* are pieces of Metal found in certain places, which being drawn away there is no more found; but the fixed Veins are those, which have a continuance in depth and length like to great Branches and Arms of Trees, and when they find *any* of them, they commonly find *many* in the same place.

Silver is sometimes found so pure by Nature as to need no refining by the Fire. Several Instances hereof may be readily met with in Metallick Writers; but the greatest part of the Silver that *we* have is found mixed with other Metals, from which it must be separated.

The Veins, where they find Silver-Ore, do usually run betwixt two Rocks, which they call the *Chase*, whereof the one is commonly as hard as Flint, and the other soft and easie to break. The Ore is not always equal in richness, and of the same Bounty; for you shall find in one and the same Vein, one sort of Ore very rich; from which they draw much Silver; and another very poor, from whence they can draw but little (c).

So that, as there is great variety in the Silver-Ore, as to its mixture with *Earth*, *Stones*, *Marchasite*, *Cinnaber*, *Vitriol*, *Copper*, *Lead*, &c. So also in its *richness*, some holding a great proportion of Silver, in respect of others: A

hundred Pound weight of Ore sometimes yields but half an Ounce or an Ounce of Silver ; sometimes two Ounces, three, four, five, and unto twenty Ounces ; what is richer is very rare, yet some has been found to hold half Silver, and some has been found so rich as to be cut with a Knife (*d*).

C H A P. XX.
Of C O P P E R.

THE Sulphureous Parts do predominate in the Composition of Copper, and from their distempered Heat arises the fiery Colour of that Metal, When it is melted, it smells more of Brim-stone than any other Metal ; and because it is over-burnt in its Composition, therefore it is less subject to injury or corruption by the Air, Earth, or Water ; it is ingendered in Mineral Stones of divers Colours, although ever the most predominant Colour is blue or green. It is generated and grows in the same places with Gold and Silver, and often-times in following a Vein of pure Copper, they have met with a Nest of the finest Gold ; but 'tis more usual to have its Veins change into Silver ; And those Veins of Copper, that make any shew above Ground, commonly prove very rich, as they are dug deeper, and consequently are more moist. The

(*d*) Dr. Brown's Account of Wind'schocht-Mine in his Travels. p. 91

Mine of *Osloque* in the *Lypes* was at the top in a manner all Copper ; and every Spades depth as they dug downwards, the Ore grew more rich in Silver, until it came to be pure Silver at the bottom of the Mine, where the Water increasing hindered them from prosecuting its farther Riches (a).

It is affirmed by several experienced Authors, that pure *Virgin-Copper* is sometimes found in the Mines, which needs no purifying by the Fire. So *Euclius* tells us (in these Words) there is found pure Copper in the Copper and Silver Mines, that is such of it self without excoction by the Fire (b). *Agricola* also says, (c) that pure Copper was not only found in its proper Veins, but also in the Silver-Mines. *Rulandus* also affirms the same, that native red Copper, free from other Metals, and so pure as not to need the Fire, was found in several Mines in *Germany* (d). And *Barba* tell us (e) that in the Hills of dry Clay he found Branches or Veins of pure Copper, like unto fine Gold. And Dr. *Leigh* assures us (f), that he had frequently seen in Copper-Mines pieces of *Virgin-Copper*, malleable without Fusion.

Cesalpinus says (g), that Copper doth in colour imitate Gold, and both it and Silver, in slowness of Fusion ; for it requires ignition before it be melted ; but that it differs from both in this, that it cannot bear the Fire, so

(a) *Barba* of Metals, p. 122, &c. (b) *de re Metallica*, p. 24. (c) *de Natura Possilium*, p. 643. (d) *Lex. Alchym.* p. 10 & 11. (e) p. 126. (f) In his Natural History of *Lancashire*, p. 88. (g) *de Metallis*. l. 3. c. 5.

long as they do, but is universally burnt ; from whence it is noted to contain much of a combustible Exhalation, since above other Metals it yieldeth a sulphureous smell and flame.

As for Copper-Ore, that must be often melted in the Fire, before it can be brought into the form of good Copper: There are divers sorts of it ; some of which were formerly found at *Keswick* and *Newland* in *Cumberland*, where much good Copper was made in *Queen Elizabeth's* time.

Mr. *Waller* says of the two Copper-Mines at *Est-kyr-kyr*, that one of them yields three Tuns of Copper out of twenty Tun of Ore, which is better then one *seventh* ; the other five Tuns from twenty, which is one out of four : And that this sort of Ore smelts into malleable Copper in one Furnace at the first running (*b*).

Dr. *Leigh* tells us, that we have in *England* quantities sufficient of Copper to supply all *Europe* ; and that if the Mines were rightly managed, we should not have any necessity to import our Copper from *Sweden*, which would be of vast Advantage to the Nation (*i*).

The Method of rightly running the Copper, which is got in the North, is (he says) by reducing the Ore to a small Powder, and afterwards roasting it, till all the Sulphur is evaporated, and then by an addition of *Lixivial-Ashes*, *Nitre* and *Tartar*, the Ore in a proper

(*b*) Essay on the Mines, p. 25. (*i*) History of *Lancashire*, p. 82.

Furnace will run to fourth part of malleable Copper (*k*).

I cannot but here take notice of a great Error, that many People run into, by imagining *Brass* to be a Metal properly so called ; whereas it is only a compound of *Copper* and the *Lapis Calaminaris* or *Cadmia*, which is a *Mineral* ; of which we have vast quantities in *Glocestershire*, *Somersetshire*, and *Notinghamshire* ; but we let it go for Ballast into Foreign Parts, before it be wrought : So that the best *Brass* beyond Sea is made of our *Calaminaris*, which deserves to be considered (*l*).

About fifty or sixty Years ago, one *Demetrius*, a *German*, did set up a *Brass*-work in *Surrey*, and with the expense of 600*l*. made it compleat and to good profit : But the *Foreign Merchants* joyning with some of *Ours*, found ways to bring him into *Law-Suits* ; and meeting with no encouragement he was at last necessitated to leave the work to his own ruin, and the unspeakable prejudice of the Kingdom (*m*).

C H A P. XXI.

Of L E A D.

L E A D is a very common and known Metal ; and there is no *Silver-Mine* where much of it is not found ; and there is scarcely any *Ore* but has some mixture of *Lead* in it. Nature has qualified it with abundance of humidity, that it might be serviceable in the

(*k*) *idem ibid.* (*l*) *Sir John Petrus's Essay.* (*m*) *Ibidem.*

melting of Gold and Silver ; by reason of its moisture it does easily melt and evaporate in the fire, carrying along with it whatsoever is not Gold or Silver, and therefore its self very easy to be refined. It is likest to Gold in weight, and to Silver in colour, and being melted together with them, not only facilitates the fluxing of them, but also helps to separate the Copper from them ; it neither corrupts nor diminishes by the Water, like Iron, but rather increases in weight and quantity : It is rarely found mixed with Gold, most commonly with Silver, and sometimes with Copper, and sometimes pure and unmixed, and needs no refining (a).

There is a great difference and disparity discernable (even to the Eye) betwixt the several Ores of Lead ; for some of it is so like to *Steel*, that the Workmen upon that account call it *Steel-Ore* ; and this being of more difficult Fusion, then ordinary, they usually mix it with other Ore, which they call *Firm* or *Frim-Ore*, to facilitate the melting of it : There is also another sort of Ore, which for its aptness to vitrifie, and serve the Potters to glaze their Earthen Vessels, the Miners call *Potters-Ore* (b).

Our *English* Lead-Ores, that are worth taking notice of (Mr. Boyle says (c) may, for distinction-sake be divided into *three* kinds ; and in each of these, there may be allowed

(a) *Barba* of Metals, p. 131. (b) Mr. Boyle's *Physiological Essays*, p. 52. (c) *Hydrostatical way of estimating Ores*, p. 212.

a Latitude for greater or lesser degrees of of Goodness; the *first* sort is of those Ores, that in the ordinary way of melting, hold some of them, from *thirty* pound of Lead to *forty* in a hundred weight of Ore, and others to *forty five* pound of the same Metal; and these by several are slighted as *mean*, and scarce, if at all, worth the working, especially those that hold under *thirty five* or *forty*.

As for the *second* sort, that reaches from *forty-five* to *sixty* Pound in the hundred. The most usual proportion I have found in many trials has been about *half* the weight of the Ore, in *clean* and *malleable* Lead. These Ores are thought indifferently good, and worth the working. But other Ores comprised in this second sort, held about *fifty-five*, and some near *sixty* Pound. And these were look'd upon not only as *good*, but pretty *rich*.

And for the *third* sort, it consists of those, that yield from *sixty* to *eighty* Pound in the hundred. And these Ores are justly reputed very *good*, especially those that come any thing near to *eighty* Pound. Mr. Boyle says, he never met with any that reacht so far (but was assured by an ingenious and skilful Gentleman, Master of the *Royal-Mint*, that he had found some *such* upon trial) nor above twice or thrice, with any that yielded above *seventy-five* Pound in the hundred: And these lookt so exceedingly promising, as if they were all Metal.

Notwithstanding this, I am credibly informed, that a Mine was lately discovered in *Somersetshire*,

setshire, that yielded *eighteen hundred* weight of good Lead in a Tun of Ore.

At *Falsot* in *Spain*, not far from *Cardona*, are a great many Lead-Mines, the Ore of which is very *rich*, and they melt it just as it is taken out of the Mine. Five Quintals of this Ore (a Quintal being 122 Pounds) usually yield four Quintals of Lead (d).

Pliny tells us, that in *his* time, *Plumbum in Britannia adeo large eruitur, ut Lex ultro dicatur, ne plus certo modo fiat : i. e. Lead was dug up in Britain in such abundance, that a Law was made to stint them to a certain quantity* (e). But the case is now so far alter'd, that new Laws are desired and enacted, to encourage the Manufacture of it, as being of great advantage to the Nation.

C H A P. XXII.

Of T I N.

OUR common Tin, *Barba* says, is begotten from the same Principles as Lead is, but more fine and better purified, whence it becomes more hard and white ; altho' from the ill mixture of its Substance it makes a noise, when one either bites or breaks it : It is the poison of Metals, and makes them brittle, that have but the least mixture of it ; and its Incorporation with any Metal alters the equal Temper it had before, and impedes its ductili-

(d) Mr. Ray's Travels, p. 472. (e) *Naturalis Historia*, l. 34. c. 17.
ty.

ty, only it does not infect Lead in this manner; because the exceeding softness and humidity of Lead penetrates into, and incorporates with the ill-tempered substance of the Tin: So that being united together, they remain fusible, ductile and malleable. In following the Veins of Tin the Miners have many times met with rich Parcels of Silver (a).

The Tin-Mines of *Cornwall* and *Devonshire* have been so ancient, that it may well be an Argument, that Nature does not decay nor Metals and Minerals cease to grow.

C H A P. XXIII.

Of I R O N.

IRON, altho' it be not the most precious, yet it is the most necessary of all Metals, for the use of Man; notwithstanding it may be disputed, whether the good or hurt it has done in the World be the greater. Nature has made it so very hard as it is, by putting over-much Earthy Parts or fixed Sulphur in its Composition, altho' it has also a sufficient Portion of Humidity or Quick-silver; so that in the first place it will not melt without a violent Fire, and the most intense degrees of Heat; and in the next, being struck with a Hammer, it does not break into small pieces, as hard Stones do, but receives impression, thereby dilating and extending it self: It is cold and dry, but more

(a) Art of Metals, p. 134.

porous than other Metals, and therefore weighs less, and is more subject to rust and decay in the wet, especially in Salt-water, which penetrates and eats into it : It wasteth in the Fire every time it is heated, falling off in Scales, because it wants Humidity proportionable to its Earthiness ; when being red hot it is quenched in cold Water, it becomes the more brittle, because the heat being pent up in the Heart of the Iron by the ambient cold, doth there prey upon and consume part of the natural Moisture, which made it tough and malleable. *This is Barba's Account of this Metal (b).*

I shall only further take notice of what Dr. Brown observes (c), that in one of the Mines in Hungary there are two Springs of a vitriolate Water, which turn Iron into Copper : These Springs lye very deep in the Mine, and the Iron is ordinarily left in the Water fourteen Days. These Waters are very profitable, seeing that the worst sort of Iron, and useles old Iron is hereby turned into the purest sort of Copper ; which has this Commendation above other, to be more ductile, malleable, and easily melted : And I have melted it (says he) without the addition of any other substance without difficulty ; whilst the Ore of Copper must run thro' so many Fires and Furnaces to be brought to any thing. In the changing of Iron into Copper in these Springs, many parts are indeed separated and lye at the bottom in Powder ; but these Parts are not Iron, but Copper ; and I have (continues

(b) p. 127. (c) In his Travels, p. 107.

he) taken of this Powder out of the Spring, and melted it into excellent Copper ; so that if the Iron be not changed, I know not what becomes of it.

The Conclusion.

I Shall conclude with Mr. *Waller's* Advice to all those who receive any considerable Advantage from *Mines*, which is (*d*), That they would appropriate a *reasonable* part of their Gains from them to *pious* Uses, and to the Service of their great Lord and Master, from whose Bounty they received them. This would be the way to bring down a Blessing from Heaven upon their Undertakings : But who can admire that Mines are sometimes unsuccessful, when Men presume to dig out the very Bowels of the Earth, enter into the Secrets of the Deep, and rifle the choicest Cabinet of Nature, without *Consecrating* so much, as the least part thereof, to *Pious* and *Charitable* Uses ?

(*d*) Essay on the Mines, p. 54.

F I N I S.

A N

Appendix.

HAVING frequently in the foregoing Pages mentioned the *Mine-Adventurers*, and the Profitableness and Advantage of that *Undertaking* to the *Publick*, I cannot but be a little surprized to find so many people, both in the City and Country, to be professed Adversaries and Enemies to it, and to cry it down. But in all Countries there will be private Interest and diversity of Opinions. And it is certain, that after all the Clamour that has been rais'd against it, the best part of Mankind will entertain a favourable Opinion of it, and be able to justifie both the Prudence and good Intention of all those worthy Persons who have engaged in that Enterprize, with as good or better Reasons, than ever any Company of Merchants cou'd give for freighting a Ship to Sea, or expecting its safe return home.

For if Men were now to begin, and the Case were to be put, whether they would venture their *Stock* at Sea, (through Storms and Tem-

M

pests

pests, Pyrates and Robbers, to the utmost Corners of the Earth; wait one, two or three Years for a return of Profit; doubtful of Success, fearful of losing all, &c.) or employ their Money in raising and Manufacturing of Mines and Minerals at *home*, within four or five Days Journey of *London*; I fancy the majority of Voices would be for the *latter*, especially if they could be satisfied in the great Advantages at *last*, as in this Case they easily may. And I do think it not impossible, nor perhaps improbable, that some Men now in being, may live to see this *Company of Mine-Adventurers* bring in more *real, intrinsick* and *substantial* Profit to this Nation, than any other Company whatsoever.

However, this is most certain, that they will have no occasion to carry any *Silver* or *Bullion* out of the Kingdom, as others do; and that they will always trade in *Staple* Commodities, that will import their full Value into *England*. Of the truth of all which *Her Majesty* is so sensible, that she has been graciously pleased lately to grant them, under the Great-Seal of *England*, a *Charter of Incorporation*, to enable them, in a Corporate Capacity, to dig and work such Mines, as they shall be legally intitled unto, and to buy and refine Ore by a Joint Stock. And indeed, who can read over the List of the Subscribers to the *Mine-Adventure*, to the number of eight hundred (the Names of a few of the principal of them being here set down) and

and yet at the same time believe, that all those Noble Lords and Gentlemen, all those Reverend and Learned Bishops and Divines, so many Ingenious and Industrious Merchants and Lawyers (and many of them particularly acquainted with *Metallick* and *Mineral* Works) should all engage in one Body, and with one Mind, in such an *Adventure*, without a good *Foundation* for it, and without considering, whether it would tend to the *Benefit* of the *Kingdom*.

A few of the Names of the Adventurers in the Mine-Adventure, as Printed in the List by Freeman Collins, May 1. 1700.

His Grace *Thomas* Duke of *Leeds*, Governour,
Sir *Humphrey Mackworth*, Kt. Deputy-Governour.

A.	The Lady <i>Ann Andrews</i> .
S <i>Amuel Atkins</i> , Esq;	The Right Honourable
<i>Roger Archerly</i> , Es-	the Lady Dowager
quire.	<i>Abergavenny</i> .
Sir <i>William Ashurst</i> ,	The Right Honourable
Knight.	the Lady <i>Diana Al-</i>
	<i>lington</i> .

Bert Cecil, Esq;
Toby Chancey, Esq;
The Right Honourable
Henry, Lord Col-
John, Lord Bishop rain.
of Bangor.

Thomas Bretton, Esq;
The Right Honourable
the Earl of *Bolling-*
brook.

The Right Honourable
Foulk Lord Brook.

Thomas Brotherton, Esq;
Thomas Burgh, Esq;
Robert Bertie, Esq;
John Butler, Esq;
Sir Robert Bedingsfield,

Knight.

Arthur Bury, D. D.

The Right Honourable
the Countess of Bel-
lamount.

John Blencowe, Esq;
John Brownlow, Esq;

C.

Hatton Compton, Esq;

The Right Honourable
the Marchioness of
Caermarthen.

The Honourable Ro-

Paul Doeminique, Esq;
The Right Honourable
the Lord Digby.

Thomas Done, Esq;
John Duckett, Esq;
The Lady Deveaux.
Robert Dobbins, Esq;
Francis Duncomb, Esq;

E.

Dr. Etwell.

Thomas Edwards, Esq;
Philip Egerton, Esq;

F.

Thomas Frederick, Esq;
Zachary Foxall, Esq;
Henry Farmer, Esq;
William Freeman, Esq;
Sir William Forrester,
Knight.

John Fowns, Esq;

G

G.
The Right Honour-
able Francis Lord
Guilford.

The Right Reverend
Edward Lord Bishop
of Gloucester.

Michael Glydd Esq;

The Right Honour-
able the Earl of
Gainsborough.

Dr. William Gould.

H.

Mr. James Hallet Gold-
smith.

Sir Joseph Herr, Knight.

Sir William Hedges, Kt.

The Lady Elizabeth
Herbert.

Sir James Houblon, Kt.

Sir Thomas Hufsey, Kt.

Sir Richard Hoar, Kt.

His Grace Duke Ha-
milton.

The Right Honour-
able Henry Lord Her-
bert.

The Honourable Ro-

bert Herbert, Esq;

The Hon. Charles Her-
bert, Esq;

Sir John Houblon, Kt.

James Hacket, Esq;

L.
John James, Esq;

George Jackson, Esq;

The Reverend Mr.

Thomas Ibbot Vicar

of Swaffham.

The Right Honour-
able Henrietta Jef-

freys.

Sir Jeffry Jeffries, Kt.

The Reverend Dr.

James.

K.

Sir Godfrey Kneller, Kt

L.

The Right Honour-
able James Lord Vis-

count Lanesbrough,

George London, Esq;

Dennis Lyddal, Esq;

The Right Reverend
William Lord Bishop
of *Lincoln*.

Henry Loyd, Esq;

The Lady *Leigh*.

John Latton, Esq;

The Right Reverend
John Lord Bishop of
Litchfield and Coven-
try.

M.

Sir Thomas Mackworth;
Bar.

The Honourable *Phi-*
lipa Mohun.

Butkley Mackworth;
Esq;

Sir John Mordant, Bar.

The Reverend Dr.
Maynard.

Arthur Moore, Esq;

The Right Honour-
able the Earl of
Montroth

William Minskall, Esq;

The Reverend Mr.
John Marshall.

N.

Robert Nelson, Esq;

Edward Nicholas, Esq;

The Honourable the
Lady *Bridget Noel*.

The Honourable the
Lady *Susannah Noel*.

John Nichol Esq;

O.

Mr. *William Oldys*.

Mr. *Thomas Osborn*.

Madam *Ann Crew Of-*
fley.

Mr. *Thomas Oldfield*.

P.

William Powel, Esq;

Daniel Park, Esq;

William Player, Esq;

George Pask, Esq;

Robert Price, Esq;

William Pugh, Esq;

The Reverend Mr.
Simon Patrick.

The Right Honour-
able the Countess of
Pembroke.

The Reverend Dr.
Ralph Perkins.

R

R.

Thomas Railton, Esq;
Her Grace Catherine.

Dutchess of Rutland.
The Right Honour-
ourable the Countess
of Rochford.

The Reverend Dr.
Richard Roderick.

S.

Mr. William Shiers, Se-
cretary.

The Lady Stonehouse.

The Reverend Mr.
Humphrey Smith.

Will. Scrimpsire, Esq;

Will. Sydenham, Esq;

T.

Samuel Trotman, Esq;

Gilbert Talbot, Esq;

Benj. Timewell, Esq;

The Reverend Dr.

Charles Torriano Re-
ctor of Hollywell.

U.

Sir Tho. Vernon, Bar.

W.

Mr. William Waller,
Steward.

The Reverend Dr.
John Wallis.

John Wallis, Esq;

Sir Edmund Warcup, Kt.

Sir Paul Whichcot, Kt.

The Honourable the
Lady Mary Wil-
loughby.

Charles Wheeler, Esq;

The Lady Arabella
Wiseman.

Y.

William Young, Esq;

Mr. Thomas Yalden,
fellow of Magdalen
College in Oxford.

Z.

The Honourable the
Lady Ann Zeulistine.

The Company of *Mine Adventurers* began with the Mines of *Eſt-kyr-kyr* alone in *Cardiganſhire*. But the ſtate of the Mines they work *now* is very different from what they were in the beginning of that Undertaking. Their Leaſe was then but for *twenty two* Years and a *half*, but now for *one hundred and ten*. Their Liberties were then limited to one Mountain, and within twelve hundred Yards in length, and two hundred Yards in breadth ; but now they have *ten* ſeveral Mines already opened in that County ; and Liberties extended many miles in compaſs, for raiſing Ore. One Liberty is thirty ſeven miles in compaſs, another above thirty ; in both which the Miners are every day making new Discoveries. They had then only Mines abounding with *Lead* ; but now they have Mines that are rich in *Silver*. In ſhort ; they had then only a *Proſpect*, but now a *Certainty*, which may be improved to great Advantage ; and the rather, becauſe they were then a *Voluntary* but now a *Corporate Society with ample Priviledges*.

And as their Mines are increaſed, ſo are their Buildings and Work-houſes to a great degree ; and, which is ſtill more conſiderable, their Workmen are greatly improved in the Art of Smelting and Re-
fining.

As to the continuance of the *Veins*, they may be compared to the Mines of *Athens*, ſet forth by *Xenophon* ; in which there appeared
in

in his time * *no sensible decay nor diminution, nor difference from their ancient State; but as they dig on, they still discover fresh Veins of Ore in all parts; and in all probability they will never be exhausted.* For all these Veins are driven to that length, that plainly discovers they are not *Bellies* of Ore, as are in some places. And all these Mines are wrought for many hundred Yards between *firm* Sides, and still grow richer, as they go farther under the Ground.

And then as to the Profit that has been made from these Mines, it appears to have been very great. For whereas it is esteemed in other Trades a great return of Profit, to make thirty or forty *per Cent.* of their Money, after all the Hazards before-mentioned, *here* they do actually make above *Cent. per Cent.* with little or no hazard.

And though a great deal of Money has been expended in carrying up *Levels* and *A-dits* to several Veins of Ore, in erecting large Work-houses, and many Furnaces for smelting of Ore and extracting of Silver from the Lead, in building Dwelling-Houses for the *Miners*, in necessary Stores, in Carriage, Freight of Ships and other Expences, yet before *December 19. 1704.* they had divided and paid amongst their Partners, *forty two*

* Εισπρασμένων ανθρώπων ἐν τοῖς ἀργυρεῖοις ἐν τῷ παντὶ χρόνῳ ναυημέτων, οὐκ οὐδὲν διαφέρει τὰ ἀργυρεῖα, ἢ ἂν οἱ πρῶτοι ἡμῶν ὄντα ἐμνέμονον αὐτὰ, &c. π. εἰ προσῶδον. p. 541.

thousand one hundred ninety four Pounds five Shillings and a Penny, as by their respective Receipts and Acquittances doth appear *. So that very few have exceeded them in so short a time, and under so many Difficulties as they must needs meet with at the first setting on so great an Undertaking, which it is well known this Company began with no greater a Stock than 20000 l. in ready Money, and 15298 l. rais'd from the Sale of Blanks and Shares held in trust for this Company (the residue of the Money raised being applied for the purchase of the Mines from the Proprietors and old Partners) and the said Stock has been employed in the *dead* Charges before expressed, which were very great, and therefore must of necessity lessen the *working* Stock, and thereby retard and hinder the more speedy manufacturing the great quantities of Ore raised, and vending the same to the best advantage.

But what great wonder is it, that *this Company* make such vast improvement of their Money, if we consider how many particular Persons have got large Estates by Mines in a few Years? Thus we are told *, That 'the Right Honourable the Earl of Darwentwater hath, or lately had, Mines of Lead in *Auston-Moor* in *Cumberland*, about thirty Miles

* Mr. *Shiers* Proposal to the Mine-Adventurers, p. 2. and his second Familiar Discourse of the Mine-Adventure, p. 21, 35, &c.

* Mr. *Waller's* Essay, p. 13.

' from the Sea, and made of his Duty (which
 ' is a fifth part of the Work) 12000 *l.* a Year.
 ' Another eminent Lord in the *North*, from
 ' one Vein of Lead, doth, or lately did, clear
 ' 17000 *l.* a Year. Another noble Lord, from
 ' one Mine, and thirty Miles from the Sea,
 ' doth, or lately did, clear above 7000 *l.* a
 ' Year, betwixt him and his Farmers. The
 ' late Duke of *Bolton* raised Lead-Ore to the
 ' value of three hundred thousand Pounds in
 ' twelve Years out of one Mine in *Yorkshire*,
 ' and got two hundred thousand Pounds clear
 ' Profit to himself †. Sir *William Blacket* of
Northumberland, having a Lead-Mine, not
 long since sold to a Merchant of *London* at one
 time 10000 *l.* worth of Lead, to be delivered
 upon *Newcastle-Key*; which accordingly was
 done. And several more such Mines there are
 in the *North* of *England*. Some poor Trades-
 men having lately purchas'd a few Shares in
 one Vein of the Mines at *Winster* in *Darby-*
shire, they are said to have got from it already
 2000 *l.* a-piece in clear Profit; according to
 that Saying of *Xenophon*, p. 541. 'Ο μὲν γὰρ εὖρε'ν
 ἀγαθὴν ἱερυσίαν πλεονεξίαν, ὁ δὲ μὴ εὖρε'ν, πάντα ἀπὸ λ-
 λυσι, ὅσα αὖτε δαπανήσῃ. *He that finds a good Vein,*
groweth rich, &c. And tho' a Man be very rich
 before he finds such a Vein; yet, as that *An-*
thor has observed, p. 539. Ἀργύριον δὲ οὐδέ τις
 πωδύτω πολὺ ἐκπύσσει, ὥστε μὴ ἔτι περὶ δεύσειν. *No Man*
was ever so over-stock'd with Money, as not to de-
sire a farther encrease.

† Mr *Shiers* second Discourse of the Mine-Adventure, p. 22.

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